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CONTENTS.

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No. 1. *July.*

PAGE

Geography and the Civil Services. By the Rt. Hon. Sir George Taubman Goldie, K.C.M.G., F.R.S., D.C.L., LL.D., President of the Royal Geographical Society 1
Inland Waterways. By George G. Chisholm (with 4 Sketch-maps) 6
The Origin and Influence of the Chief Physical Features of Northumberland and Durham. By David Woolacott, D.SC., F.G.S., Armstrong College, Newcastle (with 8 Illustrations and 5 Sketch-maps and Diagrams) .. 36
Bathymetrical Survey of the Fresh-water Lochs of Scotland. Under the Direction of Sir John Murray, K.C.B., F.R.S., D.SC., etc., and Laurence Pullar, F.R.S.E. (with Index-map, 2 Illustrations, and 2 Plates) 62
Dr. Stein's Expedition in Central Asia 71
Map of the Anglo-German Boundary from the Victoria Nyanza to Kilimanjaro 77
Reviews :—
EUROPE—Northern Sweden 79
AFRICA—Abyssinian History. German Nyasa and Rovuma Lands 80
GENERAL—The First Circumnavigation of the Globe 83
SHORT NOTICES 84
The Monthly Record 86
Obituary—Sir Dietrich Brandis, F.R.S. Dr. E. J. Routh, F.R.S. Captain J. Buchan Telfer, R.N., F.S.A. 97
Obituary of the Year 98
Correspondence—Levels of African Lakes. By Raymond E. Allen, F.R.G.S., Ch. Surveyor, U.P. 98
Meetings of the Royal Geographical Society, Session 1906–1907 99
Geographical Literature of the Month 102
New Maps 111

MAPS.

Maps of the Bathymetrical Survey of the Fresh-water Lochs of Scotland .. 116
Map of the Anglo-German Boundary from the Victoria Nyanza to Kilimanjaro 116

No. 2. *August.*

The Franklin Search: Fiftieth Anniversary of the Sailing of the *Fox* 117
From the Niger, by Lake Chad, to the Nile. By Boyd Alexander, Lieut., Rifle Brigade (with 7 Illustrations and Map) 119
A Journey from Yün-nan to Assam. By E. C. Young (with 11 Illustrations, Diagram, and Map) 152
The Heart of the Southern Alps, New Zealand. By James Mackintosh Bell, Director Geological Survey, N.Z. (with 9 Illustrations and Sketch-map) 181
Research Department: The Work of the Past Season. By Major C. F. Close, C.M.G., R.E., Chairman 198

PAGE

Reviews :—
EUROPE—Structural Geography of Iceland 199
ASIA—Indian Records. Early Enterprise in India. The Santal Parganas 201
AFRICA—Speculative Ethnology. The Herero and their Land 202
AUSTRALASIA AND PACIFIC ISLANDS—The Bismarck Archipelago. South Sea Art 204
GENERAL—Surveying. A New Text-book. Exercises in Physiography 206
The Monthly Record 208
Correspondence—The Inclosure of Common Fields. By F. Haverfield. The Heights of the Central African Lakes and Mountains. By Lieut. T. T. Behrens. The Dar Homr. By C. Percival, Captain, Rifle Brigade .. 218
Geographical Literature of the Month 220
New Maps 231

MAPS.

Sketch-map of the Southern Alps of New Zealand 182
Map of Route of the Alexander-Gosling Expedition from the River Niger to the Red Sea 236
Map of Route of E. C. Young from Lao-kai to Sadiya 236

No. 3. *September.*

Journeys in North Mesopotamia. By Mark Sykes (with 7 Illustrations and Map) 237
The Depression of Turfan, in Central Asia. By Ellsworth Huntington (with 7 Illustrations, Diagram, and Sketch-map) 254
On the Influence of Ice-melting upon Oceanic Circulation. By Dr. Otto Pettersson (with 8 Diagrams and Chart) 273
The International Council for the Study of the Sea 297
Geography and Commerce. By George G. Chisholm, M.A., B.SC. 303
Reviews:—
EUROPE—Geography of Europe. The Ancient Geography of Europe. Capri 319
ASIA—Formosa 324
AFRICA—The Egyptian Sudan. Races of Nyasaland 325
POLAR REGIONS—Peary's 'Nearest the Pole' 326
The Monthly Record 330
Correspondence—Dr. Otto Pettersson on the Influence of Ice-melting on Oceanic Circulation. By Captain T. H. Tizard, C.B., R.N. 339
Geographical Literature of the Month 344
New Maps 353

MAPS.

Map of the Basin of Turfan, in Chinese Turkestan 257
North Polar Chart 294
Sketch-map of North Mesopotamia 356

No. 4. *October.*

The Fan Mountains in the Duab of Turkestan. By W. Rickmer Rickmers (with 7 Illustrations and Map) 357
A Journey through the Eastern Portion of the Congo State. By Major P. H. G. Powell-Cotton (with 6 Illustrations and Map) 371
Journeys in North Mesopotamia. By Mark Sykes (with 6 Illustrations) .. 384
Bathymetrical Survey of the Fresh-water Lochs of Scotland. Under the Direction of Sir John Murray, K.C.B., F.R.S., D.SC., etc., and Laurence Pullar, F.R.S.E. (with Index-map, 4 Illustrations, and 11 Plates) 398
Recession of Alaskan Glaciers. By Otto Klotz, LL.D., F.R.A.S. 419

PAGE
Geography at the British Association 421
Reviews :—
EUROPE—The Rainfall of North Germany 425
ASIA—The Caucasus. Burma (Illustration) 427
AUSTRALASIA AND PACIFIC ISLANDS—West Pacific Ethnology 433
GENERAL—Early Travel 434
SHORT NOTICES 435
The Monthly Record 436
Obituary—Admiral J. F. L. P. Maclear. The Earl of Dunmore. The Rev. W. G. Lawes, D.D. 447
Geographical Literature of the Month 449
New Maps 460

MAPS.

Sketch of Part of the Yo or Waube River 439
Sketch-map of a Part of Russian Central Asia 468
Sketch-map showing Major Powell-Cotton's Route in Congo State and Uganda 468
Maps of the Bathymetrical Survey of the Fresh-water Lochs of Scotland .. 468

No. 5. *November.*

On North Polar Problems. By Dr. Fridtjof Nansen (with 2 Illustrations, 2 Sketch-maps, and Map) 469
The Fan Mountains in the Duab of Turkestan. By W. Rickmer Rickmers (with 4 Illustrations) 488
Dr. Stein's Expedition in Central Asia 503
The Course of the Upper Irawadi. By Malcolm MacLaren, D.SC., F.G.S. (with Sketch-map) 507
The Valleys of the Himalayas. By R. D. Oldham 512
Mr. Cecil Clementi's Journey across Southern China (with Map) 516
Mr. Mikkelsen's Ice-expedition in the Beaufort Sea (with 6 Illustrations and Sketch-map) 517
Western Sources of the Nile. By Lieut. D. Comyn, Black Watch (with Sketch-map) 524
The Rôle of Algal Growth in the Colonization of New Ground and in the Determination of Scenery. By F. E. Fritsch, D.SC., PH.D., F.L.S., Assistant Professor of Botany, University of London, University College (with 9 Illustrations) 531
Reviews :—
EUROPE—Physical History of Devonshire. A Corner of Devonshire. Macedonia 548
ASIA—Armenia 549
AFRICA—The Ethnography of Central Nigeria 550
MATHEMATICAL AND PHYSICAL GEOGRAPHY—Steppe Denudation 553
GENERAL—Economic Statistics. A Geographical Dictionary. Geographical Terms 554
SHORT NOTICES 555
The Monthly Record 557
Geographical Literature of the Month 569
New Maps 578

MAPS.

Facsimile of Harris's Map of Arctic Regions, showing outline of indicated North Polar land 482
Sketch-map of Direction and Relative Velocity of Permanent Current of Surface Water, as found by the *Fram* observations, 1893-96 484
Sketch-map of the Upper Irawadi 509
Sketch-map showing Sledge Journey of Captain Ejnar Mikkelsen 518
Sketch-map of the Western Sources of the Nile 527

PAGE

Sketch-map illustrating the Convention between Great Britain and Russia in regard to Persia 558
Bathymetrical Chart of North Polar Seas 584
Sketch-map of Journey from Hsün-chou Fu to Yün-nan Fu 584

No. 6. *December.*

On North Polar Problems. By Dr. Fridtjof Nansen (with Section) 585
Lord Curzon on Frontiers. By Colonel Sir T. H. Holdich, K.C.M.G., K.C.I.E., C.B. 601
Captain Percival's Surveys in the Bahr-el-Ghazal Province (with Map) .. 604
Surveys on the Mozambique Coast (with Map) 607
Travels in German, British, and Dutch New Guinea. By Dr. Rudolf Pöch (with Sketch-map and 6 Illustrations) 609
Ruwenzori and its Life Zones. By R. B. Woosnam, of the British Museum Expedition to Mount Ruwenzori (with Sketch-map, 8 Illustrations, and Diagram) 616
An Exploration of the Mustagh Pass in the Karakoram Himalayas. By Aug. C. F. Ferber, F.R.G.S. (with 2 Sketch-maps and 5 Illustrations) .. 630
The District of Jaederen, in South-Western Norway. By O. J. R. Howarth (with Sketch-map) 643
Reviews :—
EUROPE—Liverpool. The Shores of the English Channel 646
ASIA—Moab. Sinai. India 648
AMERICA—Ethnology of British Columbia. Peru 652
GENERAL—Life of Captain Cook. A Pocket-book for Travellers 653
SHORT NOTICES 655
The Civil Service Examinations. By Right Hon. Sir George Taubman Goldie, K.C.M.G., President R.G.S. 656
The Monthly Record 657
Obituary—Mr. Howard Saunders. Prof. Angelo Heilprin. Mr. J. F. Mann 669
Correspondence—On the Influence of Ice-melting upon Oceanic Circulation. By Dr. O. Pettersson 671
Meetings of the Royal Geographical Society, Session 1907–1908 675
Geographical Literature of the Month 676
New Maps 686

MAPS.

Tribal Map of Cape Nelson 610
Sketch-map of Ruwenzori, showing the Routes of the British Museum Expedition, 1906 617
Sketch-map of the Baltoro Glacier 631
Sketch-map of the Mustagh Valley 635
Sketch-map of the District of Jaederen 644
Map showing the Routes in Bahr-el-Ghazal Province 692
Map of Portuguese East Africa between the Zambezi and Pungwe Rivers .. 692

VOL. XXX. No. 1. JULY, 1907.

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THE GEOGRAPHICAL JOURNAL

SUMMARY OF CONTENTS.

(*For Details, see over.*)

	PAGE
Geography and the Civil Services. By the Rt. Hon. Sir GEORGE TAUBMAN GOLDIE, K.C.M.G., F.R.S., D.C.L., LL.D., President R.G.S.	1
Inland Waterways. By GEORGE G. CHISHOLM (*Sketch-maps*)	6
The Origin and Influence of the Chief Physical Features of Northumberland and Durham. By DAVID WOOLACOTT, D.Sc., F.G.S., Armstrong College, Newcastle (*Illustrations and Sketch-maps*)	36
Bathymetrical Survey of the Fresh-water Lochs of Scotland. Under the Direction of Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., etc., and LAURENCE PULLAR, F.R.S.E. (*Index-map, Illustrations, and Plates*)	62
Dr. Stein's Expedition in Central Asia	71
Map of the Anglo-German Boundary from the Victoria Nyanza to Kilimanjaro	77
Reviews	79

The Monthly Record. Obituary. Correspondence. Meetings of the Society. Literature and Maps of the Month.

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CONTENTS—JULY.

PAGE

Geography and the Civil Services. By the Right Hon. Sir George Taubman Goldie, K.C.M.G., F.R.S., D.C.L., LL D., President R.G.S. 1

Inland Waterways. By George G. Chisholm (with 4 Sketch-maps) 6

The Origin and Influence of the Chief Physical Features of Northumberland and Durham. By David Woolacott, D.Sc., F.G.S., Armstrong College, Newcastle (with 8 Illustrations and 5 Sketch-maps and Diagrams) 36

Bathymetrical Survey of the Fresh-water Lochs of Scotland. Under the Direction of Sir John Murray, K.C.B., F.R.S., D.Sc., etc., and Laurence Pullar, F.R.S.E. (with Index-map, 2 Illustrations, and 2 Plates) 62

Dr. Stein's Expedition in Central Asia 71

Map of the Anglo-German Boundary from the Victoria Nyanza to Kilimanjaro . . 77

Reviews :—

EUROPE—Northern Sweden. AFRICA—Abyssinian History. German Nyasa and Rovuma Lands. GENERAL—The First Circumnavigation of the Globe. SHORT NOTICES 79

The Monthly Record 86

THE SOCIETY
- Honours to Members of the Council
- The International Council for the Investigation of the Sea

EUROPE
- The Scottish Peat Mosses
- Tree-lines in the Eastern Alps

ASIA
- Dr. Tafel's Expedition to Tibet

AFRICA
- The Livingstone Memorial
- British East Africa
- The Congo Railways

AMERICA
- The Trade of Newfoundland
- Natural Mounds in the United States
- Structure of the Mexican Plateau
- Mexican Isthmus Railway

AUSTRALASIA AND PACIFIC
- A Visit to the Ke Islands

POLAR REGIONS—
- The Wellman Airship Expedition

MATHEMATICAL AND PHYSICAL GEOGRAPHY
- Ice and River Erosion
- The Idea of Direction in Relation to Rivers

GENERAL
- Dr. Krause as Geographer

Obituary—Sir Dietrich Brandis, F.R.S. Dr. E. J. Routh, F.R.S. Captain J. Buchan Telfer, R.N., F.S.A. 97

Obituary of the Year 98

Correspondence—Levels of African Lakes. By Raymond E. Allen, F.R.G.S., Ch. Surveyor, U.P. 98

Meetings of the Royal Geographical Society, Session 1906-1907 99

Geographical Literature of the Month 102

New Maps 111

MAPS.

Maps of the Bathymetrical Survey of the Fresh-water Lochs of Scotland . . . 116

Map of the Anglo-German Boundary from the Victoria Nyanza to Kilimanjaro . . 116

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GEOGRAPHY AND THE CIVIL SERVICES.*

By the Rt. Hon. Sir GEORGE TAUBMAN GOLDIE, K.C.M.G., F.R.S., D.C.L., LL.D., President R.G.S.

I SHALL not follow to-day the frequent practice at these annual meetings of summarizing the geographical history of the preceding twelve months, as I desire to concentrate your attention on one question of unusual importance, which has suddenly come into prominent notice since our last meeting. For the same reason, I shall be as brief as is consistent with an intelligible exposition of the case; for the urgency of a satisfactory solution of the question with which I propose to deal calls for public attention, and this would be distracted rather than aroused by burying the matter under a cloud of words or by allowing it to overflow into side issues.

The question is whether Geography shall be accorded a place alongside of other sciences amongst the subjects eligible by candidates for the examinations which admit to the Civil Services of this country and its dependencies. As some of you may not have noticed, or may have forgotten, how this question first came to the front, I will briefly recapitulate the main facts. For a good many years, the Foreign Office has stood in an exceptional position amongst the Civil Services of the Crown by including Geography amongst the subjects for the entrance examinations of candidates. The Foreign Office, indeed, went further by making a pass in this subject compulsory. I may say, in passing, that it is reasonable to attribute partly to this attitude of the Foreign Office the noticeable fact that, of late years, so many valuable additions to our geographical knowledge have been due to members of the

* Presidential address at the Anniversary Meeting, May 27, 1907.

diplomatic and (especially) the consular services; for Geography, with its unceasing contact with an immense range of allied sciences, has an ever-growing attraction for those who have once ventured to penetrate into its sphere. It was a reasonable matter of hope that, with the advance of education and the widening of public opinion, the enlightened example of the Foreign Office would be gradually followed by some of our other public departments. The most important of these is the Colonial Office, which administers or controls vast regions contiguous to the possessions of foreign powers, which has to initiate or supervise frequent treaties with these powers of immense future importance, and which habitually supports or rejects proposals by its local administrators for the development of their colonies or dependencies, without necessarily possessing any knowledge whatever of the economic conditions of the regions with which it is dealing. In the Indian Civil Service, the Board of Trade, and the Post Office, some elementary knowledge of geography amongst even their subordinate members would surely be of value. I am inclined to add to this list our Education Department itself, from which—not so very long ago—was despatched that often-quoted letter addressed to "Ottawa, Ontario, United States of America."

It may safely be asserted that in no country but our own would the policy have been followed of securing uniformity in the system of examinations for all the Public Services, not by levelling up to the standard of the Foreign Office, but by the opposite process of levelling down. That, however, has been our characteristically British method. After next month, Geography will cease to be a subject which candidates for the Foreign Office may even voluntarily select. It was inevitable that this remarkable decision should arouse a great deal of public attention, mainly, of course, on the ground of the maintenance of our national and imperial interests which come into touch with those of foreign nations in so many parts of the world.

This is, no doubt, a consideration worthy of much attention, but I am concerned to make it clear that the question is one of far wider importance than as merely affecting the efficiency of certain of our public services. That this fact has been so little recognized is, I think, due to a natural and even commendable repugnance on the part of cultured minds to admit that our educational systems, based nominally and to a large extent really on intrinsically sound educational principles—such as developing the thinking powers of the student, strengthening his judgment, quickening his perceptive faculties, and cultivating his memory—have also necessarily rested largely on what, for want of a better phrase, I must describe as financial considerations. These fall into two divisions. The first of them affects directly only the universities, but it affects indirectly the educational systems of all the non-State-aided schools in this country, as these for various reasons base their systems entirely on those adopted by the universities. It is

a serious misfortune that but few of the latter have been in a position to set apart sufficient funds for the endowment of a Chair in Geography or a School of Geography. Yet I do not know a single instance of a university in the United Kingdom which is indifferent on this question of geographical education. So far as I can gather—and I have taken considerable trouble to ascertain the general trend of feeling—nothing but the want of money prevents any of the universities from following the examples of Oxford, Cambridge and London. But in most cases the too scanty funds are already appropriated to older established branches of study which no thinking man would wish to see starved. Unfortunately, the Royal Geographical Society has no extensive resources of its own with which to come to the assistance in this matter of the universities generally. It has for years shared in the maintenance of the Schools of Geography of Oxford and Cambridge; but it would not be justified in advancing much further in this direction, in view of the heavy and urgent calls made upon its resources in entirely different directions. If, however, amongst its Fellows, or its sympathizers, there are any who are able and disposed to aid the advance of human knowledge by endowment, I do not think that they could better serve their purpose than by contributing to the founding of a Chair of Geography at any one of the universities as yet unprovided with a Geography School.

The other division of financial considerations to which I alluded just now is of a less simple nature, but it is not less effective in blocking the progress of geographical education and the introduction of this subject into the list of those eligible by candidates for the public services. To avoid misapprehension on this point, let me premise that I am not dealing at present with the educational systems of our State- or rate-aided schools which are not dependent on the favour of parents nor subject to competition with other schools. It will suffice to confine our attention for the moment to private schools, public schools, and, to some extent, universities, that is to say, to institutions where the sons of the leisured classes, or the well-to-do classes, are brought up, and from which strata our educational ideas and systems have invariably filtered down to the less-favoured classes which are waging a daily struggle for bare existence. With rare exceptions, every educational institution, not supported by public funds, has to some degree—though a varying degree—to strike a tacit bargain with the parents of its students; the parents paying the money on which the prosperity or, most frequently, the existence of the institution depends, and requiring in return, in the vast majority of cases, that their boys shall receive such instruction as shall best enable them to compete on equal terms with their fellow-students. The proprietors of private schools, the governing bodies of public schools, and even, though to a lesser extent, the universities themselves, cannot therefore afford to give the same prominence to a subject which carries no marks in the civil and military

examinations that they give to subjects which carry such marks. On the other hand, the Civil Service Commissioners naturally hesitate to demand proficiency in a subject which holds only a secondary position, or sometimes no position at all, in the educational institutions of the country; and the question thus moves in a vicious circle.

I do not, of course, imagine that all the sons of the well-to-do classes of this country compete in examinations controlled by the Civil Service Commissioners; but the proportion of them so competing is sufficiently large to affect very seriously the standing in the whole educational sphere of any subject, according as it is or is not a means of gaining marks in the civil and military examinations; and it may, I think, be confidently asserted that if geography received the recognition which we desire, it would very shortly take its place in Great Britain, as it has long since done in the United States, Germany, and other countries, as one of the fundamental and indispensable elements in the education of childhood and youth. That this has not been the case up to now is probably due to the unintelligent and unmethodical manner in which the subject was taught until some twenty years ago, with the result that the majority of those who are to-day in a position to speak with authority, retain an entirely false impression of its scope and objects. Certainly, during my own school life, the hour in the week devoted to geography was universally anticipated with strong aversion as a dreary exercise of the memory in acquiring names entirely divorced from the realities of life, so that one of the most human and interesting of all branches of knowledge, intimately connected as it is with the history of mankind, with our present occupations and with our future development, was presented to us as an arid and flowerless waste. The new methods and conceptions of geography have been so frequently and fully placed before you by the most competent experts in our science that I must not attempt to summarize them in this brief address. I would recommend those who are not yet informed on this point to procure and study the questions in the examination papers of the University of Oxford. They will gather from them an idea of the true scope and value of the science, and they will probably find opening out before them new and unexpected lines of thought which will add materially to the interests of their own lives. It is, indeed, to the University of Oxford, supported, as I cannot doubt that it will be, by the Universities of Cambridge, London, Edinburgh, and other great centres of education, that geographers must look for a satisfactory solution of this important question; for, so far as can be gathered from correspondence on the subject which appeared in the columns of the *Times* some months ago, the Civil Service Commissioners are willing to consider the admission of geography as one of the voluntary subjects for examinations, provided the great universities will give a lead. In taking such a step, both the universities and the commissioners will

have behind them an immense pressure of public opinion, owing to the sudden awakening both of interest in the empire as a whole, and of recognition of our widespread ignorance of its geographical conditions. The mass of cheap and, on the whole, useful literature that has recently been published on this subject, the new leagues that have been formed with the object of disseminating widely every kind of information on the features and potentialities of the various provinces of the empire, the important public meetings that have recently been held for the same purpose, and even such indications as the issue and ready sale of several new atlases containing far more detailed ecological and other information than had previously been shown—all combine to support the conviction that the educated classes of this country are awakening to the necessity of more thorough acquaintance with the various branches of our science. It is not to be denied that this new public feeling is to-day directed mainly towards knowledge of the empire. Only those who have travelled widely can fully realize the disadvantage under which British enterprise of every kind now lies, as compared with German and American enterprise, in maintaining and increasing its hold in foreign lands; but we may rest assured that if geographical interest and modes of thought are developed and established amongst us in regard to our widely scattered empire, we shall not fail to extend that interest and these modes of thought to the rest of the globe.

It may be thought by some of you that I have dealt with this subject on a too material or, at any rate, a too narrow basis; that I have dwelt exclusively on the disadvantages to our country of not emerging, as other nations have done, from geographical twilight into the brightness of knowledge; that I have said nothing of the highest of all pleasures, the love of science for its own sake. My justification is that the problem of the moment is how to diffuse over an entire nation an interest in geography, no matter on what grounds; that with every increase in the number of geographical students there will be found an increasing number of truly scientific geographers. The love of one's country and the desire for material prosperity are powerful human motives that no practical philosopher can afford to despise; while the rivalry between nations in extending the bounds of knowledge deserves his warmest commendation. Great Britain has exceptional duties to humanity in this direction. With her unrivalled history of exploration, with her predominance on the ocean, both as regards her navy and her mercantile marine, with her immense and widely scattered colonies and dependencies, with her great wealth and free institutions, she is the trustee of many talents, which she must not bury in the ground; and instead of lagging behind as she has, for many years, been content to do, in bringing up her children with some knowledge of the world they live on, it is her duty, as it will be her interest, to take her rightful place in the van of geographical science.

INLAND WATERWAYS.*

By GEORGE G. CHISHOLM.

With the exception, perhaps, of the subject of national characteristics, there is probably no subject on which it is easier and more tempting to generalize rashly than that of transport. And yet the subject is extremely complex. A very great variety of conditions have to be taken into account in determining what is really the most advantageous mode of carriage for any class of goods. In the present paper it is my duty to bring into relief the considerations of a geographical character that affect the problem. But that does not imply that other than geographical considerations are to be left out of account. In no geographical investigation whatever is it possible to proceed without any regard to considerations which must be deemed non-geographical. Even in the surveying of a country for mapping some non-geographical facts are always tacitly, if not expressly, assumed as determining the selection of the superficial features that are to be laid down. Non-geographical considerations are still more obvious in determining the degree of importance belonging to certain facts of local distribution. It is solely, for example, on non-geographical grounds that a high degree of prominence must always be given in geography to the study of climate. The nature of the non-geographical considerations that have to be borne in mind in special investigations varies with the nature of the subject. The subject of the distribution of plants cannot be handled without regard to facts which belong to the sphere of the botanist, that of animal distribution without the knowledge that belongs to the zoologist.

In considering, therefore, the subject of this evening, even from a geographical point of view, it is necessary to begin by pointing out the more important facts of a non-geographical character that have to be taken into account in dealing with the geography of the subject, that is to say, in showing or endeavouring to show how far the utility of inland waterways is affected by local conditions and place relations. It is facts that cannot be called geographical that must determine what local conditions and what place relations are of most importance with reference to the question.

Now, it is fortunate that we are in a position to recognize one important circumstance that greatly simplifies the discussion. In this country, and in all advanced commercial countries, the question is always discussed, at least avowedly, as one of economy. It is not so everywhere, nor has it always been so in our own country. In the part of the Yangtse river where the rapids occur, the substitution of river-steamers or a railway for native junks is resisted by many Chinese on the ground that the numerous Chinese trackers who get a meagre

* Read at the Royal Geographical Society, February 25, 1907.

living by doing some of the hardest work in which human beings can engage would thereby be deprived of that living. I think I remember to have read that a similar objection to new means of transport caused the boatmen of Loch Lomond to break up the first steamboat that was launched on that lake. But we have now got beyond that stage. Such considerations are no longer taken into account in the discussion of rival modes of carriage. The question is one of economy and economy only.

But great difficulties remain. Economy in transport is not determined by the mere difference in the money cost of conveying goods, say, from one town to another. The economy to be considered with reference to transport is that of carrying goods from the place of origin to the place of consumption—the carriage of coal, for instance, from the mines to our hearths, or of wheat from the wheat-fields to our tables in the form of loaves, for the place where the loaf is to be eaten has an important influence in determining where the wheat is to be ground into flour.

Those who think only of carriage from one point to another are much impressed with such figures as these. On an ordinary good waggon-road a single horse-power will draw about 3000 lbs. at the rate of 2 miles an hour, on a railway about 30,000 lbs. at the same rate, on water as much as 200,000 lbs. When it is considered, moreover, that the ratio of the paying load to the dead weight is higher in ships and boats than in road and railway waggons, the advantage in favour of waterways seems overwhelming. Yet these figures are far from settling the question. First, there is the consideration of time. In most cases a speed of 2 miles an hour is not to be thought of. Quickness of transport is becoming every day more important. It is obvious that with rapid means of transport a given amount of capital is more frequently turned over in any business, and manifestly, too, this must be a more important consideration the greater the value that is locked up in the goods carried. Now, by water transport, even under the most favourable conditions, it is nowadays more costly to develop a high speed than it is by land, and there are very few inland waterways that offer those favourable conditions. Still, speed is not equally important in all cases. The greater the bulk of the goods in proportion to their value, the heavier will be as a rule the relative cost of carriage, the more important, therefore, a money saving in transport charges, and the less urgency to that extent for economizing merely in time.

But, further, even in considering different methods of transport between two points on which a waterway is available, it must be borne in mind that great economies in transport are secured by carrying goods in great quantities. It is for this reason that British shippers keep building larger and larger numbers of large ships and increasing the size of those ships, and Americans keep building more and more powerful locomotives for the hauling of long trains composed of huge steel waggons built as light as possible in proportion to the load they carry.

On this ground the utility of a waterway must depend very greatly on its capacity.

Again, only a comparatively small quantity of goods can be conveyed direct by one means of transport from the point of origin to the place of consumption or utilization. They have mostly to be transferred from one vehicle to another. This necessarily involves cost. The cost varies greatly with the nature of the commodities handled, but in all cases it makes it important to avoid this handling as much as possible. In a report advocating a great scheme, which I shall have occasion to refer to again in this paper, it is stated that "a ton of coal is carried the thousand miles from Buffalo to Duluth for about the cost of shovelling it from the side walk into the cellar;" * and though I would not be understood to hint that when coal is handled on a large scale, the cost of handling approaches the cost of finally putting it in the cellar, still this statement is a significant reminder of the importance of this element in the cost of carriage. The advantage to Germany of being able to communicate by rail without break of bulk with all surrounding countries except Russia (where there is a different railway gauge) can be abundantly illustrated from the commercial statistics of that country. It was to secure this advantage that great railways were built across and partly through the Alps, and the numerous trains to be seen even in central Italy (how far south I cannot say from my own observation) containing waggons that have come, if we may judge from the inscriptions on them, both from Austria across the Brenner and from the Rhine valley through the St. Gothard, are a speaking illustration of the same thing. The St. Gothard tunnel had a very speedy effect in developing a trade, even in heavy iron goods, between Germany and Italy, and German coal has been carried into Italy as far as Milan, though whether that trade is still carried on, I am unable to say. Through the courtesy of the Intercontinental Railway Company and of Mr. Ernest de Rodakowski, author of 'The Channel Ferry,' an extremely interesting and instructive work written to advocate carrying on trade without break of bulk between this country and the continent by a method not open to the objections urged against the proposed Channel tunnel, I am able to illustrate this important point by some lantern slides which, I think, will speak largely for themselves.

The first shows how the trade in imported meat is carried on between Southampton and London. The meat, on being taken out of the importing ship, is transferred, not to railway trucks, but to lorries or road-waggons mounted on the trucks. Each truck is capable of carrying 10 tons, but as the pair of lorries has a weight of between 3 and 4 tons, it is clear that there must thus be a considerable addition to the dead weight hauled, even though the trucks are reduced to a simple

* This is no exaggeration. The average freight for hard coal from Buffalo to Duluth in 1904 was about 1*s.* 6*d.* per long ton; in 1905, about 1*s.* 10*d.*

platform mounted on wheels, and on the return journey to Southampton the whole train is dead weight, as no suitable freight for the carts can be found. Yet the mere saving in handling has caused this mode of transport to be carried on with satisfactory results to the company for about seventeen years.

My second illustration is one of a channel ferry-boat, such as was familiar to me in my boyhood in the earty sixties as plying between Granton and Burntisland under the name of "leviathans." The width of the crossing effected by those boats was only 5 miles, but since then the same method of transport has been adopted for crossings up to 96 miles (the widest being from Ludington to Milwaukee, on Lake Michigan). The present view shows the *Solano* on the passage from Oakland to San Francisco, a boat which carries on its four rail-tracks twenty-seven passenger cars or forty-two goods waggons of the ordinary large American type.

The third illustration shows the method by which the trucks are landed on the Warnemünde-Gjedser route between Germany and Denmark, opened on October 1, 1903, with reference to which I am able to give some particulars of direct significance regarding the subject now in hand. In the first place, I am informed that the waggon marked "Breslau" actually came from Breslau, a distance of some 350 miles from Warnemünde, 375 miles from Gjedser, and 480 miles from Copenhagen, for which it was not improbably destined. Now, if it was for Copenhagen, that was a journey on which an all-water route was available, first by means of a river accommodating boats of 400 tons burden to Stettin (305 miles), and then by sea-going vessels. Yet the rail route was preferred. On one occasion on which Mr. E. de Rodakowski accompanied the train, only six minutes elapsed between the arrival at Warnemünde and the departure of the steamer. The goods carried on that occasion were chiefly angle-iron, and I am informed by the London agent of the Intercontinental Railway Company that in the first nine months after the opening of this route 14,000 trucks and 60,000 passengers were conveyed by it; and since train-ferries were first opened for traffic in Denmark, many new industries have been developed to a considerable extent, and heavy machinery, glassware, etc., which in former years were imported into Norway, Sweden, and Denmark from England, are now being sent from Germany on the ferry-steamers.

It is the balance of advantage determined by the two considerations mentioned, the economy of carriage on a large scale and that arising from the conveyance of goods as directly as possible from the place of origin to their destination, that determines in many cases the mode of transport. It is the advantage of transport on a large scale that causes from 40 to 70 per cent. of the pepper, 50 to 60 per cent. of the rubber, and large proportions of a great many other articles imported into this country to be re-exported as they arrive, that causes raw cotton

(Egyptian) to be always one of the leading exports from this country to the United States, and causes Belfast to export directly to foreign countries (or rather to one foreign country) a greater value of raw cotton than all British and Irish goods (including ships) put together. On the other hand, to illustrate the advantage of carrying goods as directly as possible from the place of origin to their destination, I may mention as a typical case that of a paper-mill which I remember to have existed near an east coast fishing-station, not important enough to be entered in the tables of British ports, which got all its supplies of China clay and esparto in small schooners entering the fishing-harbour after voyages lasting for weeks from Cornwall and Algeria respectively. The goods were thus brought within carting distance of a mill which could use the entire cargo. To take a case more immediately cognate to the subject under consideration, the same reason explains why so much English coal for domestic use is carried long distances by rail in comparatively small waggons. It is in that way, and probably in that way only, that convenient lots of the different qualities of coal required can be brought direct from the mines within easy carting distance of everybody's coal-cellar.

Now let us apply these general considerations on the subject of transport to inland waterways and the geographical conditions affecting their utility.

It will now be manifest that inland waterways are likely to be most effective in securing traffic—

1. The greater their capacity.

2. The greater the distance for which they permit of that economy in transport which is due to easier haulage or propulsion.

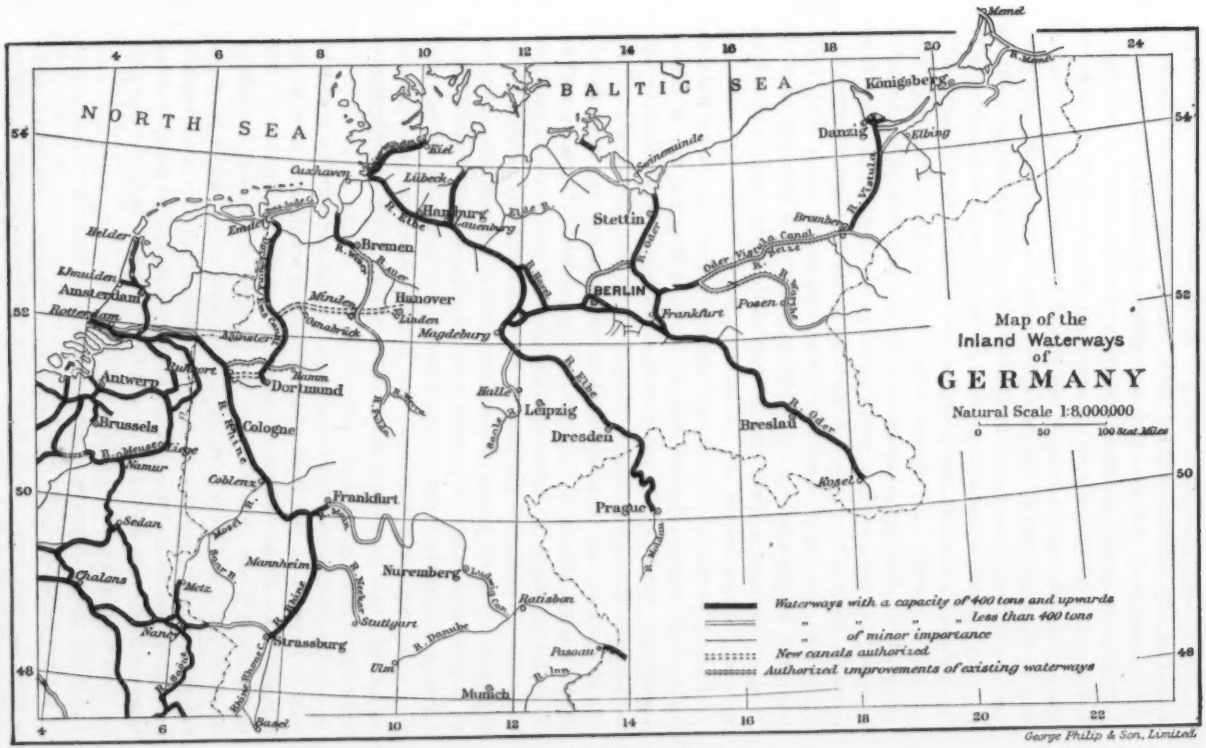
3. The more direct they are between any two points between which there is a competing means of transport.

4. The more favourable they are to rapid haulage or propulsion, a condition which, for the sake of clearness, it is well to discriminate, even though the advantage under this head is almost inevitably associated with high capacity.

5. The freer they are from such differences in level as necessitate the use of locks or other lifting and lowering contrivances, this being important, not merely in consequence of the loss of time in locking or otherwise changing the level, but in consequence of the additional expense, which varies with circumstances, being in many cases enhanced by the necessity of supplying locking water artificially, or by the impracticability of making locks of large capacity.

6. The smaller the impediments to navigation due to rapidity of current, or the occurrence of low or excessively high water, or ice.

7. The greater the amount of commodities, at once heavy and bulky in proportion to their value, procurable at some point or points on or near the waterway and consumed at other points similarly situated.



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8. The less the expense involved in the handling of commodities, including any expenses arising from damage or the risk of damage to the commodities. All kinds of coal suffer more or less in the severe handling involved in the use of waterways, but the softer kinds of course suffer most. While there is an enormous trade in coal on the great lakes of North America, coke, it is said, will not bear this mode of transport at all on account of the damage involved. Earthenware and glass may be conveyed undamaged in spite of the rough handlings to which they are exposed in water-transport, but the extra care required in packing adds to the expense, and even then the risk adds to the insurance.

9. The smaller the opportunity there is for railway or other competition. Railway competition is particularly formidable, not only because "the hard smooth road" (to adopt the description which Prof. Jevons applied to a railway) allows of far quicker transport than can be effected by any other means, but also because railways with their numerous interramifications offer the possibility of transport without break of bulk to a much greater extent than any system of inland waterways can approach.

If time permitted, illustrations might be given of the special importance of several of these factors in promoting the use of inland waterways; but time does not permit, and I will only say that it seems to me, from the examination I have given to the subject, that if any one of the nine can be singled out as the most decisive in furthering inland water traffic, it is the seventh—the existence of great quantities of bulky produce to be taken up and delivered at individual points on the same or a connected waterway. And yet, singularly enough, by far the most important article of commerce on the most magnificent system of inland waterways in the world is one of great value and small bulk; I refer to the rubber trade of the Amazon, which, it may be remarked, is a water trade solely because there is too little opportunity in that region for trade in bulkier commodities to justify the introduction of railway competition.

In order to realize the possibilities of inland water-traffic it will be well to examine in the light of the foregoing considerations what has actually been done under some specially favourable conditions. For this purpose I am able, through the courtesy of Messrs. Longmans, Green & Co., to show a map of the German waterways,* which to a large extent speaks for itself. It may be added that the improvements sanctioned by the Act of April 1, 1905, are intended to provide waterways on all the sections indicated west of the Oder for barges of 600 tons, on those east of the Oder for barges of 400 tons.

Of all the waterways shown on this map there is probably none

* With regard to the French and Belgian waterways shown in this map, it should be stated that those drawn in thick lines are those with a minimum depth of 2 metres, and that not all of these are navigated by barges of as much as 400 tons.

more worthy of study than the Rhine. It has peculiar advantages under all the heads mentioned except the last, and there is something to be said on the last head also, that is, with regard to the nature of the competition it encounters. It is (1) capacious enough to be regularly ascended by fairly large sea-going steamers as high as Cologne, by smaller sea-going vessels as high as Remagen, about midway between Cologne and Coblenz, and occasionally as high as Oberlahnstein, on the left bank of the Lahn above Coblenz, where they go to load with mineral water. Since the improvements in the gorge at Bingen were completed in 1899, barges of more than 2000 tons have been known to reach Mannheim, and those of 800 tons can reach Strassburg. (2) The distance of Mannheim from Rotterdam by water is 351 miles. The river in a large part of this stretch is (3) remarkably free from windings. The river distance is only 41 miles, about 13 per cent., greater than that by rail. (4) Powerful steamers can be used for carriage or haulage. (5) There are no locks as high as Strassburg, the present limit of Rhine navigation. There is only one to Frankfurt-on-the-Main. (6) Below Strassburg the rapidity of the current of the Rhine offers no serious hindrance to navigation, except perhaps in the narrowest part of the channel at the gorge of Bingen, though it is everywhere sufficient to make a marked difference between the rate of up-stream and down stream navigation.* The geographical conditions also tend to reduce the interruptions to navigation, from irregularity of flow and from ice. The fact that the upper Rhine is partly glacier-fed and lake-regulated tends to limit the variations of high and low water, and the westerly situation of the river is against its freezing. According to an official publication, the navigation of this river "is, on the average, annually interrupted by high water for 8 days, by ice 17 days, by low water 17 days; in all, accordingly, 42 days." † (7) At the mouth of the Rhine is Rotterdam, a world-port, and accordingly a great collecting point for all kinds of commodities, bulky and other. On the banks of the river within Germany, up to and including Strassburg, there are ten communes with a population exceeding 50,000, five of these with

* Some details may be of interest. The average speed of a train of four barges, carrying in all about 4000 tons, is given at 3 to 3¾ miles up-stream and 9 to 11 miles down. When the necessary night-rests are allowed for, the voyage from Rotterdam to Mannheim is made in summer in from 8 to 9 days, in winter in from 10 to 11 days; that from Mannheim to Rotterdam, in either case, in about 5 days. Express goods steamers, stopping at intermediate stations, ascend from Rotterdam to Cologne (190 miles) in about 36 hours = 5·6 miles an hour, descend on the return voyage in about 19 hours = 9·3 miles an hour. On the rare occasions on which a long voyage is made without stoppages, a speed of 5·3 miles an hour may be attained between Cologne and Mannheim (161 miles), one of 13·7 miles an hour between Mannheim and Cologne. Nasse, in 'Die Schiffahrt der deutschen Ströme,' herausgegeben vom Verein für Socialpolitik (Leipzig, 1903), vol. 3, pp. 142–3.

† Jasmund, 'Die Arbeiten der Rheinstrom-Bauverwaltung von 1851 bis 1900,' p. 54; quoted by Nasse in the work just cited, vol. 3, p. 138.

one above 100,000, and to these may be added Frankfurt, all great consuming centres for imported grain at least. Further, the river actually divides, below the point to which sea-going steamers regularly ascend, the most productive coalfield on the mainland of Europe, and this fact creates a demand for enormous quantities of imported ores. (8) Among the commodities grain is one that notoriously can be handled with peculiar facility, and ores, too, are comparatively inexpensive to handle. The German coal is, indeed, more liable to be damaged by handling than the harder English coal, but this is not enough to invalidate the overwhelming advantages of the Rhine for a trade in coal of local origin.

These considerations may serve to prepare one for the figures given below, stating in thousands of metric tons (each 2205 lbs.) the total traffic on the Rhine at Emmerich, close to the Dutch frontier, at the adjacent harbours which serve as the outlets of the Ruhr coalfield, and at Mannheim, the terminal point of navigation for the larger craft.

Years.	Emmerich. Passed.		Ruhrort, Duisburg, and Hochfeld. Despatched.		Mannheim. Arrived up.
	Up.	Down.	Up.	Down.	
1895	4,880	3048	3446	2005	2436
1900	9,036	4130	6225	2370	3917
1903	10,028	7211	7154	4615	4251
1905	12,533	8119	6172	4125	3942

For the sake of comparison, it may be mentioned that the total quantity carried by the Manchester Ship Canal in 1905 was 4,250,000 tons.

And now let us see how those totals were made up. In 1905 the quantity of iron and other ores that passed up-stream at Emmerich was 5,352,000 tons; that of wheat and other grains of the temperate zone, 3,250,000 tons—in all 8,602,000 tons, leaving only 3,930,000 for all other commodities. Coal made up more than half the quantity that passed down. At Ruhrort, etc., coal made up 5,940,000 tons of the 6,172,000 tons sent up, and 3,492,000 out of the 4,125,000 tons sent down-stream. At Mannheim coal and grain together constituted nearly two-thirds of the total quantity received. The quantity of goods sent down-stream was comparatively small—660,000 tons, of which salt formed the most important item.

It is instructive, also, to note some of the commodities carried by water in smaller amount, and for that purpose I have selected four of the raw materials according to the classification of the official report on the inland waterways of Germany. In this case I have taken the Rhine and the Elbe together as the water-avenues to the chief manufacturing districts of the empire.

IMPORTS IN 1905 IN THOUSANDS OF METRIC TONS AND ONE DECIMAL OF A TON, WITH THE PERCENTAGE IMPORTED BY WATER OF THE TOTAL IMPORT.

	By Rhine and Elbe.	Total.	Percentage by water.
Raw cotton	73·9	402·9	18
„ wool	40·4	165·1	24
Flax, hemp, and tow	70·2	140·6	50
Hides, skins, peltries, and leather	27·7	170·3	16

The only one of the four of which a large proportion is carried up by water is flax and hemp, and this may be accounted for in two ways—first, by the fact that this is much the least valuable of the four in proportion to its bulk; and, second, that the Elbe, by which the bulk of the import takes place, carries this commodity such a long distance on the way to the chief seats of manufacture in the eastern part of the kingdom of Saxony, the adjoining districts of Silesia, and the Austrian province of Bohemia.

The water-traffic of Berlin is also instructive. At last census the population of Berlin was upwards of two millions. The city is connected by waterways with the ports of Hamburg and Stettin, and up-stream with the river-port of Kosel, in the vicinity of the Prussian coalfield which ranks next in importance to that of the Ruhr basin. The Hamburg route has been navigable since 1894 for vessels of 600 tons burden, and on that route there are only three locks. The waterway up to Kosel has been available since 1897, in ordinary states of the river Oder, for barges of 400 tons. Owing to the comparatively small depth of the Finow canal, at present 4¼ feet, and the number of locks upon it, 17, the Stettin route is the least commodious of the three. In 1905 the total quantity of goods, including floated timber, delivered at Berlin by water, was 7,364,000 tons; and it is noteworthy that the total quantity despatched was less than one-eleventh of that, even though the shippers must obviously have every inducement to take return freight at the lowest possible rate. Of the goods delivered, those entered under two headings: (1) bricks, tiles, pipes, and other articles of baked clay, and (2) earth, loam, sand, limestone, and chalk, made up more than 57 per cent. of the total. These commodities are almost entirely of local origin. The third commodity in respect of percentage is coal, and the addition of it brings up the total proportion belonging to the first three commodities to nearly 73 per cent. The coal is partly Silesian, partly English, but in spite of the advantages afforded by the Oder, in 1901 only about 35 per cent. of the Upper Silesian coal sold in Berlin and its suburbs arrived by water.* In recent years, the

* 'Die Störungen im deutschen Wirtschaftsleben während der Jahre, 1900 ff.,' 2 ter Band, *Montan- und Eisenindustrie* (Leipzig: Duncker & Humblot, 1903), p. 157.

quantity of English coal reaching Berlin by Stettin and the Finow canal has been greater than that arriving by water from Silesia, in spite of the inferiority, and consequently greater expense, of the Finow route; one important difference in favour of the Stettin-Finow traffic being that the English coal necessarily arrives at the waterway in bulk, and has not to be brought down to it like the Silesian coal from the several mines. The coal brought to Berlin from Upper Silesia is chiefly for use in the large works alongside the waterways. For the reason already indicated, domestic coal comes mainly by rail. The same reason that keeps down the proportion of coal using the waterway from Silesia to Berlin, causes the great bulk of the Westphalian coal that comes to Hamburg to go by rail. Even the opening of the Dortmund-Ems canal, which was constructed expressly for the purpose of providing a water outlet for the coal of the Ruhr basin, has done little to develop that trade. The total quantity of goods carried down that waterway to the port at its mouth (Emden) in 1904 was just under 190,000 tons, of which 97,000 tons was coal; in 1905, 224,000 tons carried down, of which 68,000 tons was coal. Up-stream from Emden there passed, in 1905, 475,000 tons, of which 258,000 tons consisted of iron ores.

Those who advocate the improvement of existing waterways and the construction of new ones, very often lay great stress on their value as a means of carrying local agricultural produce and manufactured goods specially for export. It will, therefore, be worth while to consider what is achieved by the German waterways under these heads. For the consideration of the efficiency of waterways as carriers of agricultural produce, Germany affords no better subject of study than the great consuming centre of Berlin. Elaborate tables* drawn up in a work already quoted, written in the interest of the German waterways, enable us to make comparisons on this head. The raw agricultural products most largely carried by water to Berlin are the chief bread-grains of Germany, rye and wheat, and, on the average of the years 1896–9, about 69 per cent. of these were received by water, about 31 per cent. accordingly by rail. But nearly all this was foreign grain collected at the seaports. A different tale is told by the figures relating to potatoes. In 1899 the proportion conveyed to Berlin by water was less than 2 per cent. In fact, an examination of the data regarding the trade in agricultural products generally bears out the truth of the general statement made in the work just cited,† that "the raising of agricultural products always presupposes a relatively extensive area of production, and is thus a decentralized industry, on which account, in the great majority of cases, it is only the railways that come into consideration with reference to their transport."

* 'Die Schiffahrt der deutschen Ströme,' vol. 1, pp. 185 and 238–245.
† Vol. 1, p. 152.

Of manufactured articles carried by waterways, the only one of importance as regards quantity, except on the Elbe, on whose banks there are large centralized industries concerned in the refining of sugar and the manufacture of fertilizers, are iron and iron wares. Now, in 1905, of the raw and scrap iron conveyed to the seaports or across the German frontier, only about 25 per cent. was carried by water, 75 per cent. by rail, and all but a small fraction of the quantity carried by water went by the Rhine, that carried by the Dortmund-Ems canal being utterly insignificant. Of the iron and steel manufactures of all kinds similarly carried, the share of the waterways was about 40 per cent., that of the railways 60 per cent., and in this case again the share of the Rhine made up the great bulk (more than 95 per cent.) of the total water-borne traffic. That of the Dortmund-Ems canal was little more than 2 per cent.

So far we have considered only the really effective waterways of Germany, but some of the minor ones are also worthy of attention. For example, there is the celebrated Ludwig's canal, a waterway 5 feet deep, connecting, with the aid of other waterways, the Rhine and the Danube. What does it do? It carries on a trifling and dwindling amount of traffic, chiefly centred, as is natural, at Nuremberg, where, in 1905, the total quantity of goods received and despatched by it in both directions was much under 50,000 tons. At Kelheim this canal passed into the Danube 4637 tons of goods, chiefly timber; from the Danube towards the Main, 676 tons. Then there is the Ruhr, which flows through the great German coalfield to the Rhine, and can take barges of 165 tons—that is much larger than the great majority of English waterways. In this case it is worth while noting what it once did, as well as what it now does. In 1860 it carried in all 900,000 tons of goods, of which coal made up 868,000 tons. In 1905 it carried 1431 tons of stone down stream, and nothing up.

The result was due to railway competition, which comes under the ninth of the geographical considerations above enumerated as affecting the utility of waterways. And now it may be remembered that this is a subject on which, I have intimated, something remained to be said in connection with the traffic on the Rhine. That traffic is carried on against a good deal of railway competition. In the narrower part of the Rhine valley there is a double line of railway on either bank of the river, and there are more railways running in the same direction higher up. But the competition is not equal, I mean, not based solely on the merits of the two methods of transport. For, in the first place, the German state railways are admittedly not worked on the principle of offering the most effective opposition possible to the waterways; and, on the other hand, the states adjoining the Rhine have spent some £8,000,000 in bringing the navigation of the river to its present condition, and have handed over the river to the shippers free of toll. And

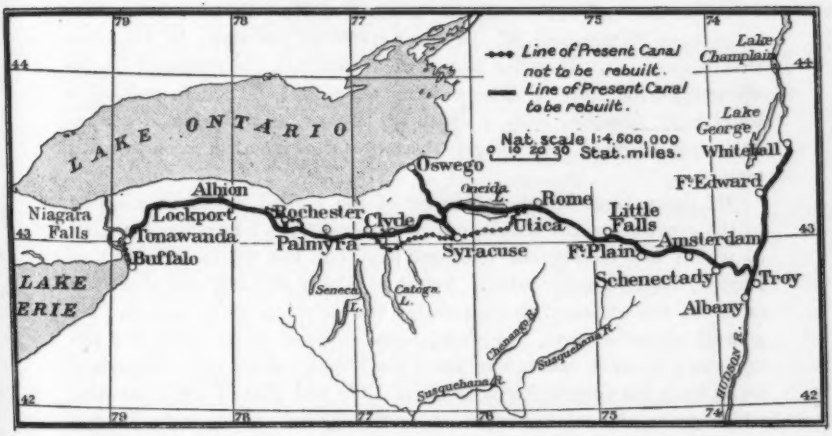
yet even under these conditions some of the shipping companies in a recent period had very bad times. In 1902 eight out of nineteen companies paid no dividend. In 1903 four paid none. Under the recent Act for the improvement of the waters it is declared that when those improvements are carried out, or rather when the Rhine-Weser canal or a section of it has been brought into operation, all those rivers on which the state has spent money in the interest of the navigation shall be subjected to such tolls as shall serve to pay a suitable rate of interest on the outlay and something towards the amortization of that outlay. This enactment has caused many of those who insist most stoutly on the advantages of water-transport, to cry out with dismay that the rivers will not be able to stand such a burden. "For the human soul," says George Eliot, "is hospitable, and will entertain conflicting sentiments and contradictory opinions with much impartiality."

Let us now turn to America. The experience of that part of the world is not without instruction for us, even though the conditions under which most of the inland water-traffic is there carried on are even more unlike those in our country than the conditions in Germany. The bulk of that traffic is the traffic of the great lakes, and so far as that is confined to the great lakes it corresponds, not to our inland water-traffic, but to our coasting trade. By far the greater proportion of it is so restricted. But the great lakes also form part of two waterways from the interior to the seaboard, one Canadian and the other belonging to the United States. The Canadian is of course that of the St. Lawrence, leading to Montreal, and has peculiar advantages for carrying on an export trade in grain. Since the completion, in 1899, of the improvements on the St. Lawrence there has been a minimum depth of 14 feet on the entire waterway. At the head of the route are the enormous grain—above all wheat—collecting points of Fort William in Canada and Duluth and Chicago in the United States. But as against these advantages it has to be remembered that the route is closed by ice for about five months or more every year. In spite of this drawback the waterway carries on an average much more than half the grain carried eastwards to Montreal. In the thirteen years, 1893 to 1905, the water-borne proportion varied from 83 to a little more than 47 per cent., this minimum having been the limit of a regular decline in the proportion of grain so carried from 1895 to 1901. By 1905 the proportion of water-borne grain had risen again to nearly 72 per cent., but in this we may probably see the effect of the abolition, in 1903, of tolls on all grain carried through both the Welland and the St. Lawrence canals, though a toll of 10 cents (say 5*d.*) a ton is still levied on all grain that passes through the St. Lawrence canals only. The meaning of this discrimination obviously is that on the heavy long hauls the railway is able to offer very effective competition even with this advantageous waterway.

The success of this waterway has long ago inspired the Canadians

with the idea of taking advantage of the geographical conditions to create a more effective waterway, offering the recommendations both of a shorter route and greater depth. This project is what is known as the Ottawa and Georgian bay scheme. The promoters of this scheme urge that by deepening in places the river Ottawa, by utilizing Lake Nipissing and its outlet the French river leading to Lake Huron, and by constructing the necessary canal connections, a waterway running nearly due west from Montreal would be substituted for that which first ascends a long distance to the south-west and then turns northwards. In that way a saving of about 340 miles in the voyage to and from the higher lakes would be saved. Further, of the total length of 425 miles on this new route 307 miles would be made up of river and lake naviga-

NEW YORK STATE CANALS
Constructing under a Law of 1903.



tion needing no improvement to admit of its being navigated by vessels of 20-feet draught. A committee of the Dominion Parliament has recommended the carrying out of the scheme and the adoption of a depth of 22 feet for the whole route. One drawback, however, is unavoidable on this proposed route. In consequence of its northerly situation, there would be only a very short season after harvest in which it would be free from ice.

The United States waterway which continues to the seaboard the navigation of the great lakes is the Erie canal with the Hudson river. This has the advantage of being connected with a much more important seaport than the St. Lawrence route, but, on the other hand, is much inferior as a waterway. It has at present a depth of only 7 feet, and the maximum size of the barges which make use of it is only about

250 tons. In this case, accordingly, we find that the railways are able to compete with the waterway much more effectively than in Canada, even though the canal is maintained by the state entirely free from tolls. On this head, however, one instructive difference may be noted between the practice in Germany and that both of Canada and the United States. In these two countries the railways that compete with the waterways are all private undertakings, and do all they can to compete with their rivals in the most effective manner. The result is that of the total amount of grain carried to New York in 1905 about 93½ per cent. was transported by rail as against some 6½ per cent. by water. In recent years, the actual quantity of goods of all kinds carried by the Erie canal has greatly diminished—from a maximum of 4·6 million tons in 1880 to less than 2 millions in 1904. And this was mainly made up of local traffic. The amount carried by the canal to tide-water in that year was considerably less than one million tons. In 1880 all the canals of the state of New York carried rather more than 25 per cent. of the total traffic of the state, in 1904 less than 5 per cent. In order to restore, if possible, the efficiency of the waterways, the state is now spending about £21,000,000 in making a canal with branches with a depth of 12 feet, and capable of accommodating barges of 1000 tons, on the routes shown on the accompanying map.

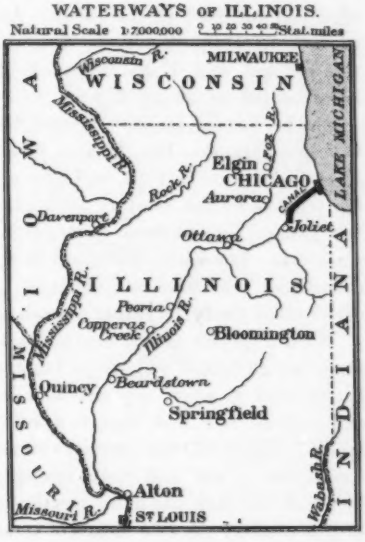
Of the natural inland waterways of the United States, in addition to the great lakes, the Mississippi offers advantages for traffic of a kind to which not merely our own country, but the whole continent of Europe, can offer no parallel. Yet it is a very striking fact that even on these the ordinary steamer traffic has shown a great decline. No general statistics have, I believe, been collected since 1889, but the tenth and eleventh censuses of the United States allow of a comparison being made between the total traffic of 1880 and that of 1889, between which years the total amount of traffic carried on steamers in the Mississippi valley generally sank from 13·6 to 10·3, that on the Ohio from 9·2 to 3·8 millions of tons. In 1901 the total quantity of goods received at New Orleans from the interior was less than 5 per cent. of that received by all routes.* Still, from the Mississippi and Ohio we can obtain illustrations of the kind of traffic in which good waterways are even now successful. St. Louis is a great collecting point for grain. In 1903 more than 80 per cent. of the wheat and about 40 per cent. of the maize despatched thence for export to New Orleans went by river, and by this route rates for wheat on through bills of lading to Liverpool are only about two-thirds of those by way of New York.† Yet the facts, even of this trade, give us a hint also of what waterways fail to

* See the data in the Foreign Office Report, Annual Series, No. 2752, pp. 4, 5.

† Foreign Office Report, Annual Series, No. 3202, pp. 48, 49.

do, for only about one-seventh of the wheat and one-thirteenth of the maize exported in that year from New Orleans came to the port by water.

But the grain-trade of the Mississippi is largely, and the still greater coal-trade of the Ohio-Mississippi almost wholly, carried on in a peculiar manner possible only in very wide, though not necessarily very deep, rivers. It is by means of what are called tow-barges—that is, a number of barges firmly lashed together and pushed onwards by means of a stern-wheel steamer. The coal is all brought from the Ohio and its feeders, the Monongahela and the Great Kanawha, the first of which is one of the two headstreams of the Ohio which meet at Pittsburg, while the other joins the main stream in West Virginia. At Pittsburg tows of barges drawing 8 feet are made up, carrying from 10,000 to 15,000 tons of coal. They may have to wait for a sufficient depth of water before proceeding on their way to Cincinnati and Louisville. At Louisville two or three Pittsburg tows may be made into one, carrying from 35,000 to 40,000 tons. Even one of 70,000 tons is on record. One carrying 40,000 tons, Prof. Johnson tells us, is about 10 acres in extent.*



At the same ratio, one of 70,000 tons would extend over 17½ acres—say 140 by 600 yards.

It is boasted that this is the cheapest mode of inland carriage in the world, and yet even this traffic, which increased enormously between 1880 and 1889, would appear to be now declining in the aggregate, and is certainly not keeping pace with the enormous progress of the American coal trade generally. In 1889 the total amount of freight carried on the Ohio was officially returned at above 16,000,000 tons, of which tow-barge traffic made up considerably more than 12,000,000 tons. In a consular report for 1905, the total traffic of all kinds was estimated at 11,000,000 tons,† and the figures in the official returns for the coal trade

* Emory R. Johnson, 'Ocean and Inland Water Transportation' (London: Appleton, 1906), p. 364.

† For. Off. Rep., Ann. Ser., No. 3622, p. 35.

of the Great Kanawha in recent years are at least not progressive.* This, no doubt, is the cause of the demand made by those interested in the Ohio navigation for the improvement of that river by the Government of the United States, so as to afford a minimum depth of 9 feet at low water, a demand to which the Government has so far acceded as to obtain from Congress appropriations for a survey of the entire river for that purpose.

But a still greater project is now being agitated, one, namely, for the creation of an uninterrupted waterway of 14 feet in depth from Chicago to Orleans, so as to allow of loaded sea-going vessels passing from the one port to the other. An association, known as the Lakes-to-the-Gulf Deep Waterway Association, has been formed to carry out this scheme, and I am informed by its secretary that its total cost is estimated at about £14,500,000. Part of the proposed waterway would be formed by the Chicago Sanitary and Ship canal, connecting Chicago with the Des Plaines river, a canal with a minimum depth of 14 feet, begun in 1892, and now approaching completion. This canal the trustees of the Sanitary District of Chicago propose to hand over to the general government on condition that it completes the projected waterway; but when one considers that the 42 miles of this canal, when completed, will have cost about £11,500,000, the total estimate above given must surely be rather sanguine.

Such a project as this may at least serve to give an idea of the enthusiasm which inland waterways inspire in the minds of some people, but is not fitted to afford any guidance in the study of English waterways, and to these it is now time to devote attention. With reference to the special subject of this inquiry, namely, the influence of geographical conditions on rail and water transport, there are few countries, if any, in which the facts are more worthy of study than our own, seeing that in this country the two means of transport have been left to fight it out between themselves, with little interference on the part of the State. It has been the general rule in other countries, as in Germany and the United States, for the State to intervene on behalf of the waterways. In this country the only way in which the State can be said to prejudice the railways in the contest is in insisting, in the case of those canals which have become railway property, that the canals shall be maintained whether the railway can work them at a profit or not, and that the owning companies shall, at the demand of traders, quote rates subject to State regulation. I would not be understood to assert that this is undue interference on the part of the State. I merely mention it as at least a fact that should be recognized.

And here I may point out that the existence of railway-owned and

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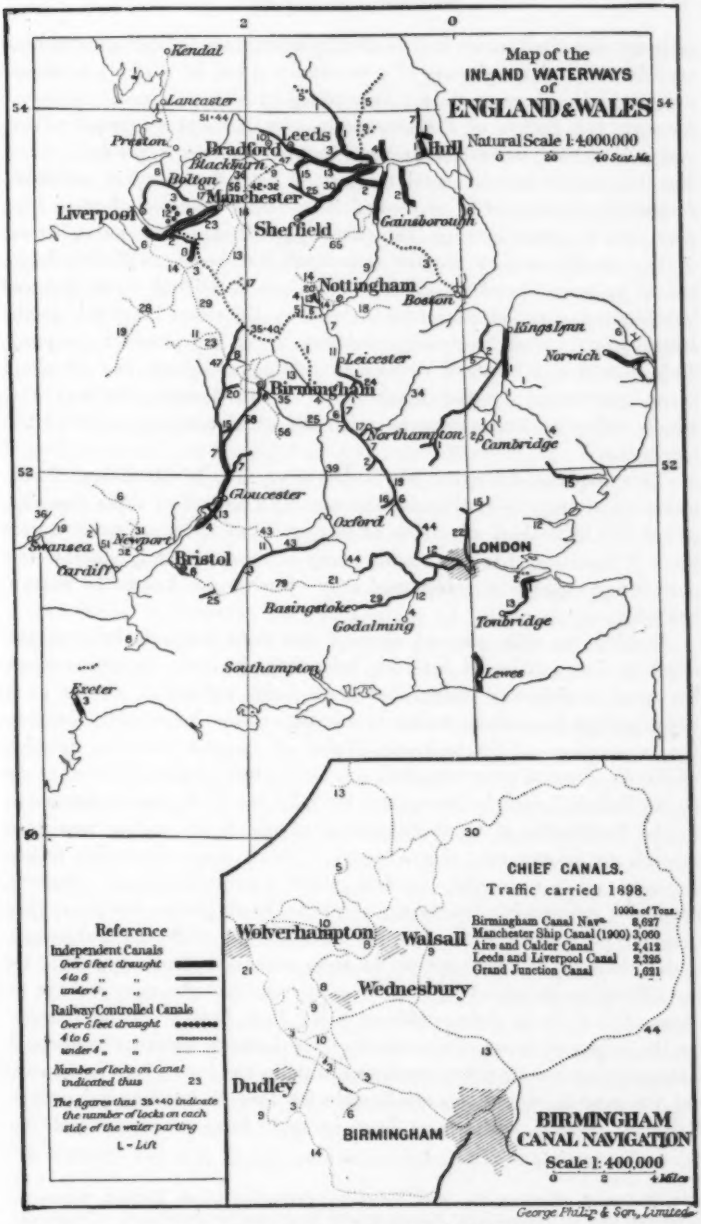
* See the Annual Report of the Chief of the Engineers of the War Department of the United States for 1905, vol. 6, part 2, pp. 1886–7.



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railway-controlled canals in this country introduces another geographical consideration, although only of a secondary order, by which I mean one not originally given or mainly determined by nature. Once established, however, the nature of the ownership may have geographical effects, and it is at least incumbent on us to inquire whether it has such or not. For that reason several canal maps have been drawn up in which the distinction of ownership or control is indicated, and one of these I am now able to show through the courtesy of Messrs. Longmans, Green, & Co. On this map, it should be noticed, the canals are distinguished, not as railway owned and independent, but as railway controlled and independent; for this makes an important difference, inasmuch as the Birmingham Canal Navigation belongs to an independent company. This, however, is a mere dividend-receiving company, the dividend being guaranteed by the London and North-Western Railway Co., which under an old agreement with the canal company controls the navigation.

This map also, following the well-known map of Mr. Lionel Wells, makes an attempt to distinguish the canals in respect of their capacity, and it will be noticed what a large proportion of them are small waterways of less than 4 feet in depth, many being not merely shallow but narrow and capable of being used only by what are known as narrow boats.*

Further, on this map an attempt has been made to indicate the effect of inequalities of level on inland navigation. In one respect the most satisfactory maps that have been published, so far as I know, giving indications under this head, are the large maps showing the waterways of England and Wales, of Ireland, and the Scottish midlands respectively, attached to the paper "On Waterways in Great Britain," read in November, 1905, by Mr. J. A. Saner, M.INST.C.E., to the Institution of Civil Engineers, of which the author was good enough to favour me with a copy. These maps show the waterways in relation to the physical features as indicated by contour-lines and intervening colouring. It is to be regretted, however, that they do not give the number of locks on the different waterways, which the scale of the maps would have made comparatively easy. Of the difficulties presented by English canals the best idea may perhaps be obtained from the sections published in Mr. E. A. Pratt's 'British Canals.' On the map now shown the number of the locks on different canals and waterways, or sometimes on sections of canals, has been given in figures, but the map is on rather a small scale for that to be done quite satisfactorily. It will, however, at least serve to keep us in mind of the

* The work affording the most complete information about English waterways under this and all other heads connected with their use, is Bradshaw's 'Canals and Navigable Rivers of England and Wales,' by H. R. de Salis (London, 1904).

fact that in this respect English waterways mostly suffer from great drawbacks.

It may be worth while to examine some of the more important canals separately with reference to this point. It will be noticed that there are three waterways connecting South Lancashire with the West Riding of Yorkshire, and, accordingly, crossing the Pennine chain; two of them independent canals, the third railway owned. The most important of these is the Leeds and Liverpool canal, the northernmost of the three, which, it will be observed, has fifty-one locks on the one side, forty-four on the other. It has, however, the easiest route of the three, going through the important feature which Mr. Mackinder has well called the Aire gap, at the height of only 477 feet above sea-level. The Rochdale canal, the next to the south, rises above 500 feet, and the Huddersfield canal reaches its summit, 656 feet, in the Stanedge tunnel 3 miles long. In the Harecastle tunnel, 4 miles north-west of Stoke, the Trent and Mersey canal attains a height of 460 feet. Birmingham is connected with the Thames by a waterway which starts at 380 feet above sea-level, sinks to 180 feet in the valley of the Avon, and rises again to 390 feet where it passes through the Chilterns; and with the Severn by one starting at 425 feet above sea-level, and making a rapid descent of about 250 feet in 3 miles after passing through the Tardebigge tunnel.

It has also to be noted that, in addition to railway competition, the inland waterways of this country have to encounter that of the coasting trade, and when all the drawbacks of English waterways are considered, it is not too much to say that in proportion to their capacity as regards volume and speed, the work done by them compares very favourably with that done by the waterways of other countries with which it is reasonable to make a comparison. In the absence of ton-mile statistics no satisfactory comparison can indeed be made under this head; still, it may be not altogether useless to mention that the tonnage carried by the waterways of England and Wales, according to the returns for 1898,* was larger than that carried by the waterways of France, Belgium, Germany, or Russia, for the nearest year for which I happen to have the data (in no case more than three years from 1898). England and Wales, moreover, have no waterway like the Ruhr, capable of carrying 165-ton boats and passing through a coalfield, yet carrying next to nothing. The 113,000 tons carried in 1898 by the Kennet and Avon canal and river Avon (railway controlled, be it observed) compares very favourably with the small traffic of the Danube-Main or Ludwig's canal.

The first question, therefore, to ask is, How is it that our poor waterways accomplish so much? and unquestionably the answer is, Because this country has such large quantities of bulky goods originating or

* 'Returns in Respect of Canals and Navigations in the United Kingdom for 1898. [Cd. 19], 1899.

collected at some point on a waterway and requiring to be transported to some other point on the same or a connected waterway.

We may next ask how this traffic is divided between the independent and railway-controlled waterways. In making this comparison, I leave out the sea-borne traffic of the Manchester Ship canal, which is obviously not on the same footing as ordinary inland water-traffic, and I omit the Manchester Ship canal proper in stating the total length of the canals. On this basis we find that the 2016 miles of independent canals carried in 1898, in round numbers, 22·5 million tons, the 1118 miles of railway-controlled canals roughly 13·5 millions. These figures would seem to tell rather in favour of railway control, but, of course, it would be absurd to draw such a conclusion. Such general comparisons throw no light whatever on the question. It will be more profitable to look at the facts relating to some of the individual navigations.

That which carried by far the greatest amount in that year was the Birmingham Canal Navigation, a miserable narrow-boat system of waterways which wind about and rise and fall in South Staffordshire and the neighbouring parts of adjoining counties. But it is their situation that explains their pre-eminence, the large towns and the mines and quarries of this district supplying and requiring large quantities of bulky produce, such as is indicated in the following table, one column of which is taken from the returns already cited, and the second kindly supplied to me by the clerk to the Navigation :—

THOUSANDS OF TONS CARRIED BY THE BIRMINGHAM CANAL NAVIGATION.

	1898.	1903.
Coal	4543	3786
General merchandise	1340	1336
Bricks	846	612
Road materials and manure	655	769
Pig iron	523	434
Ironstone and cinder	478	411
Sand	139	135
Lime and limestone	103	63
Total	8627	7546

The "general merchandise," I am informed, is broadly composed of grain, timber, and manufactured goods generally.

The waterway ranking next after the Birmingham Canal Navigation in respect of the volume of its traffic is the Aire and Calder Navigation. Here we have a much better waterway, throughout above 6 feet in depth, with much fewer locks, and, moreover, with large quantities of one bulky commodity (coal) to collect at or near its upper terminals, Leeds and Wakefield, and discharge into ships at its lower end, Goole. This trade has also been greatly promoted by the ingenious contrivances for dealing with this commodity devised by the engineer to the canal, Mr. W. H. Bartholomew, M.INST.C.E. The coal is carried in so-called

compartment boats, really segments of a boat, each carrying 35 tons of coal, and formed into a train which is preceded by an empty segment shaped like the prow of a boat, all drawn by a tug. On the arrival of the train at Goole, each compartment is hoisted up in order that its contents may be tipped into the hold of a ship, and on the return of the train the separate compartments are hauled out of the water on rails to be taken to the collieries for refilling.

Time fails us for the examination of other important English waterways, but attention may be drawn to two railway-controlled canals which carry a great deal of traffic, though not with such satisfactory results as the Birmingham Canal Navigation. One of these is the St. Helen's or Sankey Brook canal,* belonging to the London and North-western Railway Company. It is above 6 feet in depth, and runs from the great chemical and glass manufacturing town of St. Helens to the Mersey. In 1898 it carried above 380,000 tons of river sand, chemicals, limestone, sugar, and other produce, but at a loss to the company of £835. It is difficult to conceive what motive the company could have for carrying all this at a loss, if in any way it could contrive to carry it at a profit. The other is a very remarkable and instructive case in more ways than one. It is that of the Swansea canal,† which lies in the valley of the Tawe, and in 16½ miles ascends 333 feet by means of 36 locks. In spite of these adverse circumstances, the canal carried in 1898 192,000 tons at a small profit to the railway company. The explanation is found, however, in the account of it given in the Returns for 1898, where the canal is described as "passing through or alongside the various works—copper, silver nickel, tin-plate, and other works, also collieries, quarries, etc." But the instructiveness of this example does not end here. In 1898 the goods stated to have been carried by this canal in order of importance were coal, ores, and pitwood. The manager of the Great Western Railway Company has been good enough to inform me that in 1905 the total tonnage carried by this canal was only 123,000 tons, and that the decrease in traffic was mainly due to the fact that, consequent upon the provision of rail access to a large colliery company's works, that company's output, which formerly passed by the canal, was now all carried by the Midland Railway, and that it was understood that the colliery company had disposed of its water-carrying plant. The coal at present carried by the canal amounts to less than 6000 tons per annum, and I am assured that, as might be expected, practically the whole of the canal traffic arises at, or is destined for, places in the vicinity of the canal. Now the traffic is carried on at a loss, and in this case it is still more difficult to conceive what inducement the company has to suffer that loss if it can prevent it.

* This is the canal shown on our map by five large dots to the north of the Mersey.

† This canal, inadvertently shown on the map by a continuous instead of a dotted line, is the western of the two canals converging on Swansea.

There can be no question, however, that in some cases it must be the interest of the railways to check the development of canal traffic. If the facilitating of traffic on a canal belonging to a railway would tend to divert traffic to other canals instead of the railway, it is in accordance with ordinary business human nature that the railway should be unwilling to grant such facilities, and it is largely on this account that the principal schemes for canal improvement in this country hinge upon the Birmingham Canal Navigation. That, of course, is not the sole reason. The concentration of a mining and industrial population on the area served by that canal affords one of the important conditions favouring through traffic by water to the coast. In the paper already referred to M. Saner has propounded a scheme for connecting this area with the ports of Liverpool, Hull, London, and Bristol by canals capable of being navigated by lighters of 250 tons carrying capacity. But suppose, as Mr. Vernon-Harcourt suggested in his criticism of that scheme, a beginning were made with a project of more modest dimensions, "the actual enlargement of the most promising canal, such, for instance, as the Worcester and Birmingham canal," let us consider, in the light of what has been set forth, what would be the prospects of traffic on that improved waterway to the sea. The Birmingham area, it may be admitted, is more promising for canal traffic than Berlin. It is rather to be compared with a portion of the area of the Ruhr coalfield. Still the waterway thus provided would be no Rhine. It would not even be equal to the Dortmund-Ems canal, the disappointing results of which we have already seen. When all the circumstances are considered, the probability is, it seems to me, that nearly all the commodities enumerated above as making up the water-traffic of the Black Country would still continue to form merely local traffic. Not improbably there would be some development in the carriage of iron manufactures to Bristol, a development hindered, as compared with the Dortmund-Ems route, by the inferiority of the waterway, but relatively favoured through the superiority of the seaports with which Birmingham would be connected. In return there would not improbably be a certain trade in ores, how great it would be difficult to estimate, but so far as it went it would no doubt be a gain to the district. From the experience of Berlin and Germany generally, we may take it as settled that the improved waterway would do little to promote the trade in English agricultural produce. On the other hand, it would help to increase the competition of foreign and colonial produce of that kind with that of home production. Those, therefore, who advocate the spending of public money on canals ought to consider whether this trade, among others, is one that it is desirable to promote by special bounties, such as an unremunerative state-built canal would constitute.

Before the paper, the CHAIRMAN (Colonel G. E. CHURCH, Vice-President): This evening we have a lecture on an extremely interesting subject—Inland Waterways

—by Mr. Chisholm, whom you all know. He has devoted the last twenty years to the question of practical geography, and the world is greatly indebted to him for the work that he has done. His treatises, text-books, and atlases are well known, and his 'Commercial Geography' is a standard not only in the English language, but it rivals any similar work in any foreign tongue. Naturally, his researches have led him to study inland waterways in all their relations to the commercial development of countries, and therefore we may expect from him information of no ordinary value this evening. I have now the pleasure of calling upon him to read his paper on "Inland Waterways."

After the paper, Sir CHARLES WATSON: It is to be regretted that Mr. Vernon Harcourt is not here to-night, because he could have given us most valuable information on this subject, but unfortunately he is abroad. I have been his colleague at two International Navigation Congresses in Italy and in Germany, and have had the opportunity of seeing some of those places which Mr. Chisholm has described, and of discussing this question with foreign engineers and others who are interested in the subject. I have also lived for more than a year on the banks of the Mississippi, and have had considerable opportunity of studying the important question of navigation on that river. The conclusion that I have arrived at is, that the conditions of inland navigation in every country are different. If we take, for instance, Holland, where there is a flat country, and where there are canals without locks, they are undoubtedly most valuable. There is another country, in fact, two countries, that Mr. Chisholm did not mention, where inland waterways are of the greatest possible value. I allude, of course, to Norway and Sweden. There you see carried out to the fullest extent what he regards as one of the most important principles—that is, that the goods which are to be carried can be brought without difficulty from the point where they are produced to the point where they are required. I allude to the great timber traffic in Scandinavia. There, too, you have the curious fact that the ice and snow, which in most countries hinder waterway traffic, are really of the greatest assistance. If you are there in winter, you see that they are able to bring down the trees from the forests by chutes on the snow, and are able to float them down without the least difficulty to the point where they are to be shipped. In countries like these, where the rivers bring down many thousands of tons of timber every year, waterways are of the greatest possible value. But if, on the contrary, you have a country like England, where the surface is undulating, where there must be numerous locks, and where there is not always enough water to serve those locks, it is very doubtful whether canals can ever be as useful for us as railways. It must not be forgotten that canals were introduced into England at a time when railways were not thought of. Prior to the introduction of canals in the eighteenth century, all the traffic had been carried by road, and, for the most part, by bad roads. Of course, Telford had not then made his excellent roads, and many of the routes were of a very inferior description. Canals were a vast improvement; but in the early part of the nineteenth century the railways were introduced. It must not be forgotten that one of the main reasons which was urged for the introduction of railways was that they would be very superior to canals, because the prices charged for traffic on canals was so high that it was considered the railway would help to reduce those prices, and would take the traffic more conveniently. Having regard to all the circumstances of the case—though I speak with hesitation on the subject, because there is at present a Royal Commission sitting, and I think we ought perhaps to wait until we hear the results of their deliberations, which will give us the latest ideas of canal traffic in the United Kingdom—I cannot help feeling that it would not be justifiable to spend either

the money collected by taxes or by rates on British canals for the sake of some manufacturers and traders. I do not see why the whole of the community should pay in order that a small proportion should get their goods carried a little cheaper. But at the same time I would only say that it is a most interesting subject, and that the more you study it—and I suppose it is the same with all subjects—the more you find how much there is to learn.

Sir HENRY TROTTER: My only excuse for saying two or three words is the fact that I have lived for the last twelve years on the banks of the lower Danube, a river which has only been casually alluded to this evening. It rises in the Black Forest in Germany, and has a course of about 1200 miles before it reaches the Black sea. I have only had to deal with the lower part of the river, that is, the last hundred miles of its course. That hundred miles is under the jurisdiction of a European Commission, which was constituted in 1856, after the Crimean War, with the mission of clearing the mouth of the Danube from obstructions. Instead, however, of lasting for two years, as originally intended, its work has been so successful that it has lasted for fifty years instead of two, and celebrated its jubilee last year. When the commission first began its labours there were 9 feet of water on the bar and 8 feet in the river. Early in 1894, when I first became connected with the Danube, those dimensions had increased to 24 feet on the bar and 18 feet in the river. At the present moment we have 24 feet on the bar and 20 feet in the river, and it is most gratifying to know that the success of those engineering works is almost entirely due to an Englishman, Sir Charles Hartley, a most distinguished engineer, who, after serving in the Crimea during the war, was appointed engineer to the Danube Commission, and up to this day, fifty years later, he is still its consulting engineer, although about to retire next month. I will give you some idea of the advantage that has accrued to commerce from the improvement of a single waterway. I must confess I was rather startled at the figures given by Mr. Chisholm. Till I heard them, I always had a much higher opinion of the Danube than I have at this moment, because I find there are so many canals in our own country which carry a greater traffic than the Danube. From 1850 to 1860 the average annual number of British ships entering the Danube was 205, with a mean capacity of 195 tons. From 1896 to the present date the average number has increased to 420 ships with a mean capacity of 1769 tons. The largest record of British ships was in 1893, when there were 905 vessels aggregating 1¼ million tons, capable of carrying about double that amount of cargo. In that year British shipping accounted for 88 per cent. of the total shipping frequenting the Danube. The principal exports from the Danube are cereals from Roumania and Bulgaria, and timber from the Carpathian mountains. The export of cereals from the Danubian ports in 1867—the first year for which authentic records are available—was 2½ million quarters, which is about the average of the ten preceding years. Forty-two years later it was 17½ million quarters, while the average for 1893 to 1895 was 12½ million. In the same interval freights from the Danube to the United Kingdom have fallen from 45*s.* to 10*s.* per ton, or from 9*s.* to 2*s.* per quarter.

Mr. HENRY HUNTER (chief engineer of the Manchester Ship Canal): My only apology for intervening is that for thirty-four years I have been engaged in the construction and in the operation of inland waterways, and I cannot but feel that something should be added to the observations which have been addressed to us to-night by the author of the paper. I began my connection with inland waterways in the reconstruction of the river Weaver navigation in the county of Chester in the year 1873. Mr. Chisholm has spoken, and spoken with accuracy, of several cases in which waterways have been found, by those who controlled them, for one reason or another, unable to compete with railway-borne traffic. The river Weaver

Navigation, upon which the main traffic is the carriage of salt, is an exception to that rule. From the inception of that waterway efforts have been made to keep it up to date, and the result is that, although for nearly fifty years desperate efforts have been made by some of the greater railway companies, including the London and North-Western, to divert the traffic from that waterway to their own routes, their efforts have been entirely unsuccessful: so that the traffic continues still to be borne on the waterway despite the competition of the railway companies. Then again, I have been connected for nearly a quarter of a century with the Manchester Ship Canal, and I ask to be allowed to supplement, from the point of view of our experience in connection with the railways, the observations which the lecturer has made. I have been engaged for some considerable time in extending the terminal accommodation of the canal in Manchester. In the year 1905 His Majesty the King opened a large new dock. A few weeks before the dock was opened, Sir George Nares came over to see these new dock works, and he brought with him a gentleman who is an officer of the Board of Trade, and who spoke of a well-known Manchester merchant, and said, "I was dining at his house last night, and I told him that I was coming down to see the Manchester Dock. And he said to me, 'My firm has £40,000 in ordinary shares in the Manchester Ship Canal. We have never received one halfpenny of dividend; we never consigned a bale of goods by it; we have neither imported nor exported by it. And yet,' said he, 'we think that we never invested money to greater advantage.'" Now, that point of view has been omitted by the lecturer to-night. Sir Charles Watson reminded me of it. He was the British representative at the St. Louis Exposition, and at St. Louis I had the opportunity of saying something about the inland waterways of this country, and of referring to certain figures which were to illustrate the point. A manufacturer in the Potteries District had, as it happened, in 1904, orders in his works for considerable quantities of pottery goods for London and for New York. The goods were in his packing warehouse at the same store, and, through a mistake on the part of the packers, some of the crates which were intended for London were sent to New York. The error was not discovered until they were well on their way across the North Atlantic, when a cable was sent, saying, "Send crates back direct to London." That manufacturer was able to show that the crates which he sent directly from Tunstall to London cost him the ordinary rate of 25*s.* per ton for railway carriage, while the crates which he sent from Tunstall to New York, and thence to London, cost him 15*s.* per ton. So that it may be said that the cheapest route from Tunstall to London is *viâ* New York. I suggest to you that the point of view relating to reduction of railway rates by canal competition ought not to be lost sight of in considering the question of the value of inland waterways in this country.

Mr. HERBERTSON: When Mr. Chisholm addresses us he always gives us something to think about. To-night he has shown us an example of his skill in dealing with the very complicated problems of economic geography, a skill which has given him the position of one of the leading authorities, and made his book the best book, on the subject.

I agree with the speaker who said that the more you study the problem of inland waterways, the more complicated it becomes. It is very easy to give many instances of this. Some canals can carry coal at a profit, other canals cannot do so. In some cases coal is brought by rail because the railway station is at a higher elevation, and it is easier to cart downhill than uphill. Where the canal is higher, coal may come by canal for the same reason. As Mr. Chisholm has pointed out, one has to be very cautious. The case of the Erie canal is an example in which caution has to be used in coming to conclusions. In 1905, on the Erie canal

every available boat was in use, and some were such rotten hulks that the insurance companies would not insure the cargoes. That was due to the Erie canal being in a transition stage, and hence we cannot draw satisfactory conclusions from the present state of the Erie canal traffic.

Mr. Chisholm very rightly insisted on the importance of quick delivery, but occasionally one finds the waterways are chosen because they are slower, even when more expensive. In the reports issued by the Foreign Office, you will find an account of how, when the Russian wheat comes into Antwerp in autumn, part is sent to Strassburg by the Rhine in fifteen days at 6*s.* 6*d.* per ton. Another part is sent eastward to the Meuse and along the Rhine and Marne canal to Strassburg, taking six weeks and costing 9*s.* 6*d.* per ton, but the importer at Strassburg saves warehousing and gets delivery after he has disposed of the wheat brought up the Rhine.

This problem of inland waterways has very properly been brought before the Geographical Society, because the geographical factor is very important in this as in all transportation problems. At first sight transportation services would seem to overcome the geographical factor, but the great centres and routes of traffic are very definitely controlled by geographical conditions, and, indeed, the geographical factor becomes more instead of less important. The orography of the country has to be examined very carefully. The water-supply has to be considered from a political as well as from a physical point of view. One must know, not merely how much water there is, but what water is available, and a map is required showing exactly how much water can be obtained at the present time that is not assigned to other purposes. The geographical factor comes in the economic as well as in the engineering problems of inland waterways, and it would be easy to add to the illustrations of this which Mr. Chisholm has given. Here, too, new maps, showing not merely actual economic conditions, but economic potentialities, are badly wanted.

There is one aspect which Mr. Chisholm has not emphasized to-night, and that is the value of comparative geography in the problem. The south-eastern counties of England have orographic conditions very similar to those of the Paris basin, with alternate scarped ridges of porous limestone or chalk and impervious clay plains between. The rainfall and the conditions of water-supply are not very different. The agricultural conditions may be a little better in the Seine basin owing to the more southern latitude. A careful analysis is needed to show how far, with fairly similar physical conditions, the economic conditions of the two regions differ. This has a practical bearing on the problem of inland waterways in this country, because it is stated that along the Rhine-Marne canal a very large proportion of the traffic is due to industries which have sprung up since the canal was constructed. But another precaution has to be taken, because there have been great improvements in methods of transport by road, rail, and water since this canal was made. Before coming to conclusions from French conditions, we have to take into consideration, not merely comparability of the physical and economic conditions, but how far recent improved methods of transport affect the problem.

Mr. Arthur Lee: As one of those who took an active part in the agitation which brought about the appointment of the Royal Commission, and as one of the two witnesses nominated by the Associated Chambers of Commerce to give evidence before that commission, I am glad of the opportunity of saying one or two words. I was very glad to hear what Mr. Hunter had to say, because this appeals to me rather more as an economic than as a geographical question. I think everybody in this room will agree that cheap transport is a national advantage. Where do we find that transport is cheapest? What are the countries in which transport is cheapest? We find, invariably, that transport is cheapest where water-communica-

tion is best. The railway rates generally in existence in this country have been carefully compared with the rates charged in European countries. We pay on an average 8 per cent. more than the French, 31 per cent. more than the Germans, 33 per cent. more than the Belgians, and 35 per cent. more than the Dutch. Now, how has that reduction been brought about? There is an invaluable paper—a Foreign Office paper—which was written by Consul-General Hertzlet a year or two ago, and he points out that, in consequence of the improvement of the waterways in Belgium and in Germany, illustrations of which you have seen here to-night, between 1888 and 1903 a selected series of rates have been reduced by 30 per cent. Why has no improvement taken place in England? It is because of the policy pursued by the railway companies towards the canals. They have been left, to use the lecturer's words, to fight it out between themselves, with the result, that the railway companies' rates, where there is no effective water-competition, are very much higher than the rates where there is effective water-competition. I have examined a number of railway rates from the two important ports of Bristol and Hull. The average comes out in this way. Where there is effective water-competition, other things being equal, the rates are 38 per cent. lower than to points where there is no such competition. The Birmingham district has been alluded to by the lecturer to-night, and he has suggested there is only local traffic there, and only likely to be so in the future. Now, some two or three years ago it was my duty to go to Birmingham to see if I could rouse the Birmingham people to action in this matter, and I pointed out then, that the district imported something like three million tons a year of timber, grain, copper, tin, lead, and zinc, and that by an improvement in the canal communication of the Severn they might save probably something like half a crown a ton. But if they saved only a shilling a ton, that would be £150,000 a year, and it might be profitable to the district to provide public money for that particular purpose, for the reason that, as all consumers benefit by competition amongst traders, all consumers pay rates for carriage, whatever they are, in the long run. But it does not pay private persons to expend money on the improvement of canals, because immediately they do so the railways make a dead set at them, and make that particular traffic point unprofitable. They are able to do so by charging higher rates to places where there is no such competition. But it would pay the whole community to put a waterway in order, even if not a ton of goods passed by that canal, if as a consequence they were able to get lower railway rates. May I point out to you that in America, which has been suggested as a place from which we might gain important lessons, when the water routes are blocked by ice, the railway rates go up for those particular months of the year. And Commissioner Finke, of New York, has said with regard to the Erie canal, over which only a small percentage of the total traffic goes, that the railway rates are kept in check by water-transportation. This explains why New York State is ready to spend 21 millions in improving that canal. The real point is that the railways have a practical monopoly in this country, and the only means of combating this monopoly is by means of canals, within limits, of course. Nobody knows better than those who have studied the subject, that canal traffic must be conducted under very strict limitations. I don't want anybody here to be alarmed at the suggestion which has been made to-night by one speaker, who said he did not see why public money should be expended to enable some people to get their goods cheaper. Now, I have never advocated the expenditure of State money; I have spoken against it—unless with local guarantees. If you have local guarantees and a local provision of some money, you can then safely give State aid, because the State gets its interest guaranteed locally, and the taxpayers are guaranteed against loss by the particular district which is benefited by cheaper freight. With these limitations, I do not see

why there is any geographic, economic, or engineering difficulty in the way of providing public funds to enable us to put our waterways into order, at all events in as good order as they are found in the great commercial countries of the Continent.

Mr. PALMER: The last speaker has mentioned the very points that were in my mind, and he has covered so well the grounds of Mr. Hunter's narrative, which shows how cheap water-carriage is to be obtained, that at this late hour I do not think I can usefully say anything further. The lecturer spoke of the canals between Liverpool and Wolverhampton as being of very small gauge, but notwithstanding that, they carry a very large amount of traffic. That shows that although the canals work at a great disadvantage, it shows the value of water-carriage. The annual tonnage in England and Wales, according to the last Board of Trade returns, was, I think, something more than 34,000,000 tons. It should be remembered that this 34,000,000 tons is with very antiquated canals. On the French canals they have only arrived at about the same tonnage—I forget the exact figures—after having improved their canals and spent something like sixty millions on them. They thought it worth their while to improve their canals when their tonnage was very much smaller—I think under 20,000,000 tons, but I am not sure of the figure—and if it was worth their while to spend such a large amount of money to improve their canals in order to get cheap carriage, well, it is worth while for something to be done in England to make improvements which will give us cheap carriage. We have been called a nation of shopkeepers, but, at any rate, we are behind other nations in the matter of cheap carriage.

The CHAIRMAN: I take the view that canals are a national blessing, for they modify the pretensions and the monopoly of the railways, and I quite agree with Mr. Lee's view—in fact, I am indebted to Mr. Lee for saving me from making some remarks similar to his own. Canals really dictate low railway tariffs, and every nation could afford to undertake the cutting of them for Government account. Take the Erie canal. Twenty years ago it cost 2*s.* to send a bushel of wheat from Chicago to New York. Thanks to that waterway, it now costs 5*d.*, and the New York Central Railway is absolutely obliged to base its tariffs on the cost of carrying grain by the Erie canal. There are twenty-seven railway bridges across the Mississippi to-day, indicating the terrific competition between railway and water-borne freights. Throughout the United States the rivers and canals have made freights as low as they are; the average railway rate there to-day is two-thirds of a halfpenny per ton a mile. It will be lower, for the United States has in hand eighty million sterling projected outlay for improving its waterways, and there is now a Bill before Congress for the expenditure of seventeen million sterling on account of that eighty millions. The large project from Chicago to New Orleans which has been mentioned will also bring the railways to a realizing sense that it is their duty to the public to carry freight as low as they can and make a reasonable interest on a proper capitalization. I have no doubt the Danube regulates the railway rates in Austria and Hungary, that the Suez canal even influences the rates on the Trans-Siberian Railway, and that the principal value of the Panama canal will be to lower trans-continental railway freights. I am not going to detain you any longer. The subject with its ramifications is so vast that we might continue talking about it for a month. We have only to thank the lecturer for his extremely interesting paper, and also the gentlemen who have taken part in the discussion, which has given additional value to the lecture.

Mr. Chisholm, at the meeting, confined himself to a brief expression of thanks and of gratification at the discussion that had been raised by his paper, and excused himself from replying on account of the lateness of the hour. He now desires,

however, to take the opportunity afforded him of replying to criticisms. Some of the omissions to which attention was called were due solely to the necessity of compression, more particularly in the reading of the paper, some of the points referred to as overlooked being expressly noted in the paper as written and printed. Several instances of transport costs adduced by different speakers serve very well to show how complex the problem of transport is, but they may be described as belonging to the curiosities of transport, each demanding special inquiry, whereas in the paper an attempt has been made to ascertain the normal and typical. The objection most frequently urged by critics was that in the paper the indirect influence of low water rates on railway rates was overlooked, and it was contended that indirect benefits of this kind may more than make good direct losses on water transport. The fact of such indirect influence is unquestionable. The author of the paper, in the later editions of his 'Commercial Geography,' has quoted without one word of dissent the opinion of an American railway-traffic manager to the effect that the influence of the Mississippi in the making of rates is almost conterminous with the Rocky mountains on the one side and the Atlantic on the other. In the case of effective paying waterways like the Aire and Calder and the Weaver navigations, the influence, both direct and indirect, on transport charges must be regarded as wholly salutary; but, in reply to those who think that this consideration would justify the expenditure of public money either derived from the general revenue of the country or (less objectionably) from the districts principally interested in canals not expected to pay directly, the author of the paper would invite attention to these considerations, which, it must be confessed, take us rather far from the field of geography. It must be admitted that the indirect influence of navigations like the Aire and Calder and the Weaver would be still greater if these navigations renounced all profits on their business, but no one surely would contend that in the interest of the general public it is their duty to do so. If it is recognized as reasonable that such private companies should earn such profits as they can, it would seem to be reasonable, also, that waterways constructed with public money should be made to pay if they can. Now, it cannot be questioned that any benefit that would accrue indirectly to the general public from the construction of a waterway with public money must come through the traders. They must benefit not merely primarily, but chiefly, and, above all, those traders who deal in the commodities in which waterways are able to compete most effectively with railways. If, therefore, it is proposed to construct with public funds a waterway which admittedly will not pay under the existing conditions of competition, it would appear to be reasonable for the district supplying the money to ask for powers to levy contributions in support of the waterway from those traders who would principally benefit by it whether they sent goods by the waterway or not. Otherwise the benefit is distributed out of proportion to the burden. Let us suppose, then, that powers were granted to levy rates in the interest of the waterway on railway-borne goods, especially of those classes in respect of which the competition of waterways with railways is most serious. What would the effect of that be? The railways have, in consequence of the indirect influence undoubtedly exercised by the waterway, reduced their rates compulsorily. This levying of rates in the interest of the waterway would be in effect a raising of the railway rates, but not an undue raising so far as the traders are concerned. Much of the traffic would thus be driven to the waterway. The waterway might thus be made to pay, but would this method of making it pay not bring into glaring relief the injustice that would be done to the railways?

THE ORIGIN AND INFLUENCE OF THE CHIEF PHYSICAL FEATURES OF NORTHUMBERLAND AND DURHAM.*

By DAVID WOOLACOTT, D.Sc., F.G.S., Armstrong College, Newcastle.

In a paper on "England and Wales viewed geographically," Dr. Mill has shown that geology to a certain extent, and geography to a far greater, derive much of their interest from the causal idea. (1)† Geological and geographical phenomena may be considered from two distinct standpoints, firstly, from that of their origin and development—mainly the province of the geologist—and, secondly, from that of their bearing on humanity, its places of settlement and lines of movement, chiefly the work of the geographer. When the geologist views the topography of a country, he sees a series of panoramic changes leading up to the present configuration; but to the geographer the existing contour is in its broader outlines unchangeable, and he endeavours to trace the influence that this immutability of the surface has on mankind. In this paper I desire to examine the physical features of Northumberland and Durham from two separate, but closely connected, positions, viz. that of their geographical evolution, and that of their influence on the determination of the place of town and city, and routes of migration and commerce.

The Pennine chain and Cheviot hills form the main gathering-grounds for the waters that flow over the two north-eastern counties. The former is a faulted anticlinal of Carboniferous rocks, the latter is an igneous massif of the Old Red Sandstone age. From them the rocks dip gently towards the east and south-east, and the rivers are, and in former times were much more, adjusted to this fundamental geological structure. The time at which the evolution of the present topography of Northumbria began is hypothetical, as it is almost impossible to fix with any certainty the period when the era of deposition gave place to that of denudation.

From the available evidence, it is impossible to make any definite assertion as to whether the Pennines were ever entirely covered by any of the deposits of the Mesozoic age; it is, however, clear that the extent of country that was covered by the Upper Cretaceous sea would be such that very little denudation would be taking place within the two north-eastern counties of England, and, consequently, the initiation of the present topography of the country would not take place until the post-Cretaceous uplift. If any one desires to pursue this subject further,

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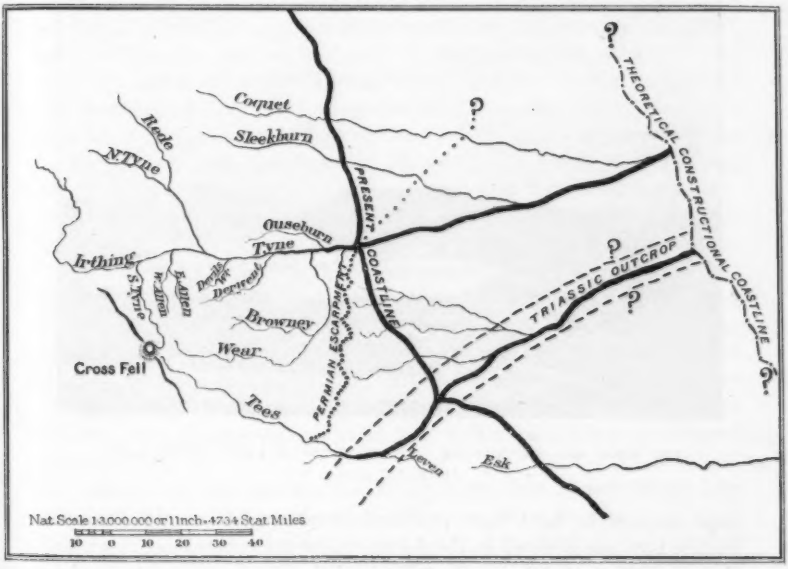
* Research Department, April 19, 1907. Sequel to a paper on "The Superficial Deposits and Pre-Glacial Valleys of the Northumberland and Durham Coalfield" (*Quart. Journ. Geol. Soc.*, vol. 61, 1905, pp. 64–96).

† Numbers between parentheses refer to Bibliographical list at end of paper.

reference should be made to papers (2) to (5), whose titles are given in the bibliographical list annexed to this paper.

The movement of elevation that began in early Tertiary times, and culminated during the Miocene period, ushers in the most influential cycle of river development in the two north-eastern counties. It made Britain throughout the Tertiary age a part of the European continent, and the greater portion of the area at present occupied by the North Sea, dry land. The elevation was greater in the west, and the land sloped gently from the Pennines towards the east, corresponding roughly with the dip of the strata; thus a series of consequent streams, having

Map of Northumberland and Durham showing the direction of the chief rivers prior to the Glacial period.



their source in the Cheviots and Penninces, was initiated. The constructional shore-line probably lay far to the east and north of the present coast-line; indeed, for a considerable period all the rivers were tributary to a major stream running along the middle of the North Sea area. An era of sub-aërial denudation held sway over Northumbria, and continued without a break from the Miocene to the Glacial period. It was during this protracted epoch that the pre-Glacial valleys of the northern counties were developed, the escarpments of Tynedale and Weardale gradually evolved, (6) and the broader features of the present topography produced. The chief escarpment of the two counties is that

of the great intrusive sheet of the Whin Sill, which runs in an almost continuous scarp across Northumberland from Gilsland to the north of Belford. The outcrop of this rock has been of considerable historical importance, and is of some geographical interest. Along it for about 18 miles the Roman Wall of Hadrian was built, and the castles of Dunstanborough and Bamborough, which in early days acted as foci for places of human settlement, were erected on it. The Northumberland lakes partly owe their origin to it, and it has added to the beauty and variety of the northern coast of Northumbria.

The most noticeable feature of the uplands of the two north-eastern counties is the centric development of the South Tyne, Wear, and Tees, which are all dip-streams flowing from the Crossfell area. This arrange-

THE WHIN SILL ESCARPMENT, WITH CRAG LOUGH LYING AT ITS BASE.
(*H. Mitchell, photo.*)

ment appears to have been produced by the uplift of the Pennines having been accentuated in the region, where the culminating summit of that range lies. In the north of England the Pennines form a complete water-parting between the east and west of England, except along the line of the Tyne Gap, which is a valley cutting across the Pennines at an elevation of less than 500 feet, and consequently forming a natural commercial route between the east and west of Northern England. This gap, as well as the development of the South Tyne, Wear, Tees, and other streams from a central area, can be clearly seen on any physical map of England. Mackinder, in his 'Britain and the British Seas,' (7) suggests that the source of the Tyne once lay in the region of the Solway Firth; that the Nith and Annan were its headwaters; and that the Tyne Gap, though ultimately due to a local

downfold transverse to the Pennines, was the former course of the upper Tyne. On this hypothesis the Eden, a river possibly of later development, whose valley is cut in the soft and unresisting New Red deposits, must have caught up these headwaters. It seems much more probable that this transverse valley has been eroded by the Irthing, now a tributary of the Eden, but which has been proved to have been, even in post-Glacial times, one of the Tyne. (8) This easterly flowing stream would be confluent with the South Tyne, which from Haltwhistle to Hexham is a strike stream. It was also during this period that the valleys of the southerly flowing Redewater and North Tyne, and those of the easterly flowing Tyne and Coquet were developed. The drainage of the west of Northumberland is quite distinct from that of the east, a feature due to the Corbridge fold, the axis of which runs from the Cheviots to the Tyne, near where Corbridge now stands. Prof. Lebour says of this structure, "It was a long, low-arched saddleback or anticlinal, the result of which was that only to the east of it did the beds dip steadily to the east, whereas on the other side they either lay flat or gently rolling."(9) The influence of this fold in separating the river-basins of the North Tyne and Redewater from that of the rivers flowing eastward into the North Sea has been considerable. Its axis forms a watershed dividing the drainage of the west of Northumberland from that of the east. The valleys of the Tweed and its tributary the Till, which flows along the eastern foot of the Cheviots, were also formed during this cycle.

Cowper Reed, in his 'Geological History of the Rivers of East Yorkshire,' shows that at the beginning of this epoch the Wear would be a tributary of the Tees, which flowed right across the Jurassic outcrops in the line of the present Leven and the Esk. Both these rivers were afterwards beheaded by subsequents, the Wear by a tributary of the Tyne that had developed along the edge of the Permian escarpment, and the Tees by a parallel stream, which had worked back along the Triassic outcrop. (10)

During this era between the Miocene and Glacial periods the pre-Glacial valleys of the northern coalfield were produced. In my paper on these valleys, (11) it is proved, from a study of the borings made in that area, that the present rock-surface of the country lies, in a great number of places, at a considerable depth beneath sea-level, reaching a maximum of 141 feet, and that the trend of these points is along certain more or less clearly defined lines—the paths along which the pre-Glacial streams ran. These valleys, now filled or partly filled with superficial deposits, are shown in most cases to be the continuation of the higher reaches of the present river courses, and in others to bear little or no relation to them. They, however, afford us a means of reconstructing, with tolerable accuracy, the drainage prior to the Glacial period; besides, they prove that during this cycle of river development the land must have stood higher than at present. The pre-Glacial Wear, flowing along the partly

filled valley of the "Wash," debouched into the Tyne; the trend of the last-named river in that era was very similar to that of the present one; while the pre-Glacial valleys of the "Sleekburn" and the "Druridge" existed further north; and in his 'Great Ice Age,' Prof. James Geikie proves that the pre- and post-Glacial courses of the Tweed differ from one another considerably. (12) It is shown in my paper that the slope of the rock-floor down the Tyne valley is not—so far as can be gained from the borings made along it—uniformly eastwards, but as the valley form can be traced down its entire length, there seems to be no other possible explanation of the origin of this valley. (13) The peculiarities of its slope, which appears to be of a switchback nature, must be due—if they really exist—to differential earth-movements subsequent to its development. Besides the major pre-Glacial valleys, there are numerous minor tributary watercourses; indeed, all the so-called "washes" that occur on the surface of the northern coalfield are of this nature.

It is only in the uplands of the northern counties that the primary adjustment of the rivers to the dip and strike of the rocks holds good now, because only in these regions are they flowing entirely over the rock-floor; in the lowlands the streams now run over a varied platform of rock and boulder clay, and are not adjusted to the lie of the rocks (see p. 44).

The main pre-Glacial valleys of the Tweed, Tyne, upper Wear, and Tees are broad; and the drift which now partly masks them has been levelled out, so that they have become the easiest and busiest routes for the lines of east and west human movement in the north of England, and the chief places of settlement have been fixed along them. Thus Haltwhistle lies at the junction of the pre-Glacial "Tyne Gap" and the South Tyne, Hexham at the junction of the Tyne and North Tyne, while along the valleys of these rivers numerous towns and villages have been erected. Corbridge lies on a wide flat of assorted drift, Newcastle and most of the other large towns of the lower Tyne stand on drift within the line of the pre-Glacial valley. Along the Wear, Stanhope, Bishop Auckland, Durham, and Chester-le-Street are all situated on the course of the valley of earlier development.

It is certain that this period of greater elevation during the Tertiary age is the most important so far as the development of the present topography and physical features of Northumberland and Durham are concerned. During the whole of this long cycle the surface of these two counties was being eroded without cessation by the forces of sub-aërial denudation, and if the conditions had not changed a "peneplain" would have been gradually evolved.

The next cycle of river development commences with the passing away of the Ice age. The ice filled up the major existing valleys and checked their development; it also carried with it the screes lying at the foot of the escarpments, which were rounded and polished and made

less distinct features. Along the valleys little or no denudation had been done by the ice, and except that it had smoothed their sides and rounded off the irregularities of their contour, it had not altered their course. During the period of maximum glaciation there were several iceflows passing over the two north-eastern counties, which, while more or less distinct on the higher ground, gradually merged together on the lower. One swept round the Cheviots from the south of Scotland, and passed southwards over the coastal region of Northumberland and north-east Durham; another crept across Northumberland from the west, filled up the Tyne valley, and turned southwards over central Durham; a local one moved down the South Tyne and united with the last; the Wear and upper Tees formed separate gathering-grounds of their own; while the ice from the Eden valley and the Lake District passed over Stainmoor and then down the valley of the Tees. All the main streams, viz. those from the south of Scotland and western England, and those down the main river valleys, received a southerly component due to the pressure of the main mass of ice occupying the North Sea, which came very near to, although it probably never reached, the coast of either Northumberland or Durham. Many of the valleys of the Cheviots, and some of those tributary to the Tyne, were not filled with ice, and hence

DRY SLACK, SHOWING GAP IN WATERSHED, HUMBLEDON HEUGH, CHEVIOTS.
(*Dr. J. A. Smythe, photo.*)

glacier lakes were formed in them, and the overflows from these have eroded deep, clean-cut, and often quite dry channels across water-

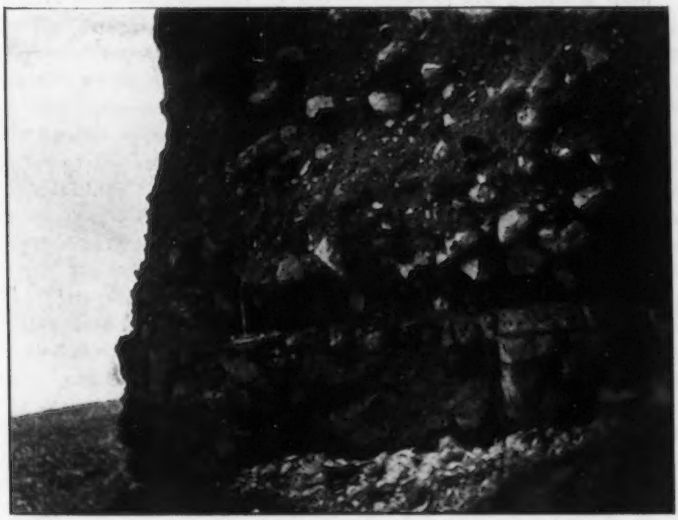
BOULDER CLAY, HENDON BANKS, NEAR SUNDERLAND, AFTER STORM, NOVEMBER, 1903.
(*D. W., photo.*)

sheds. (14) Many such slacks occur on the Cheviots and on the higher ground between the Allen, Tyne, and Derwent.

Also at the end of the period of glaciation the ice appears to have melted from certain districts over which no main sheet was passing, as that of central Northumberland, quicker than it did along the country covered by the main iceflows, and hence ice-dammed lakes occupying large areas were formed, and overflows from these have cut channels across the minor watersheds on the lower ground. Some of the dry slacks occurring on the coalfield to the north-west of Newcastle are of this nature, and the gap in the Magnesian Limestone escarpment at Ferryhill, through which the North-Eastern Railway runs, was also produced in some such manner as that here stated.

After the glacial period the main valleys formed prior to that time were partly, and many of the minor valleys entirely, filled with boulder clay and other superficial deposits, little or no evidence of their existence being left on the contour of the country. The new rivers of the post-Glacial epoch began to carve their valleys under new conditions, on land already partially eroded but standing at a lower level than in the former cycle of river development, and on a new platform of denudation consisting of rock and boulder clay. The valleys of the higher reaches of the pre-Glacial streams which had not been entirely obliterated by the mantle of drift became the natural

waterways of the new era; but as they were partly filled up, new channels had to be cut, and hence a great thickness of the original superficial deposits has been removed or reassorted. The river terraces of the Tyne and Wear, which are found in the former river valley as high as the 300-feet contour-line, were produced from the drift that once filled it up to and above that level. (15) Another consequence of this denudation of the glacial formations is that the Tyne, Wear, and Tees have, in many places along their course and for long distances, wide haughs formed of reassorted drift. The rivers are manifestly not carving out new valleys, but superposing a new watercourse on an older



BOULDER CLAY RESTING ON MAGNESIAN LIMESTONE, HENDON BANKS, NEAR SUNDERLAND. LOCAL ANGULAR FRAGMENTS AT BASE OF CLAY, AND FOREIGN SUB-ANGULAR BOULDERS ABOVE.

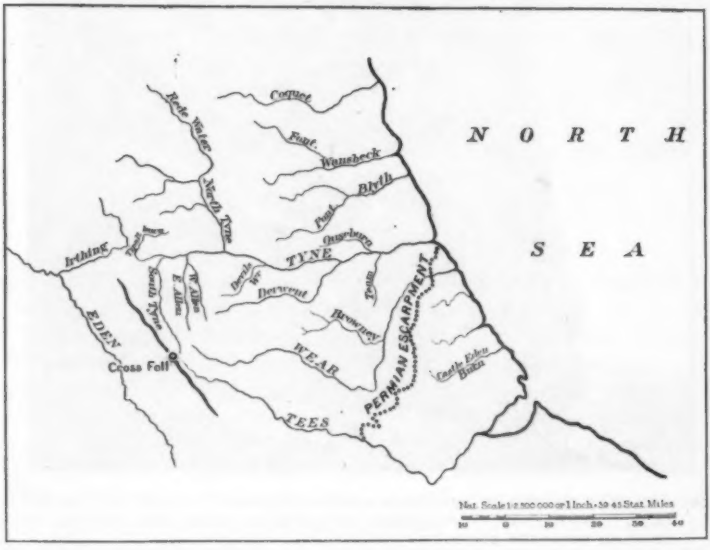
(*D. W., photo.*)

one of larger, broader, and deeper dimensions. The wide alluvial flats have evidently had an important effect on the determination of the direction of the principal routes of commerce, and the situation of the towns and villages. The railways have been laid along the haughs of the post-glacial streams. The Newcastle to Haltwhistle line follows the course of the Tyne, and its principal branches pass into the more secluded parts of the country along the pre-Glacial valleys. The North British branch from Hexham into Scotland creeps along the side of the North Tyne, and the Haltwhistle to Alston along the South Tyne. The main line from Darlington to Newcastle passes into the pre-Glacial

Wear valley near Durham, and then along the "Wash" into Newcastle, while the Wear valley branch follows the course of that river right into the heart of mid-Durham. Newcastle, Blaydon, Hexham, and Haltwhistle lie on the alluvial flats of the Tyne, and Durham, Bishop Auckland, and Stanhope have been erected on those of the Wear.

Along the lower reaches of the rivers many changes have taken place, the tracks of the streams that developed on the new land surface being in many cases totally different from those of the pre-Glacial. Sometimes the newly formed waters have totally left the old valleys and denuded entirely new paths, *e.g.* the Wear from Durham to Sunder-

Map showing the present rivers of Northumberland and Durham.



land; while in others the new rivers keep in the direction of the old thalweg, only deviating from it at certain points, as in the case of the Tyne below Newcastle; also several entirely new waterways have been produced, *e.g.* those of the Wansbeck and the Blyth; and, yet again, some of the ancient valleys were so entirely masked by the superficial deposits that no evidence of their existence has been left on the topography of the country, and they could only be traced by the borings that have been made along them. The "Sleekburn" and the "Druridge" pre-Glacial valleys are the chief examples of such, but numerous minor "washes" exist on the coalfield. The latter can, however, only be clearly elucidated by the thorough examination of each particular

district by local workers. A fuller description of the difference between the drainage of the pre-Glacial and post-Glacial surfaces will be found in my paper on "The Superficial Deposits and Pre-Glacial Valleys of the Northumberland and Durham Coalfield." (16)

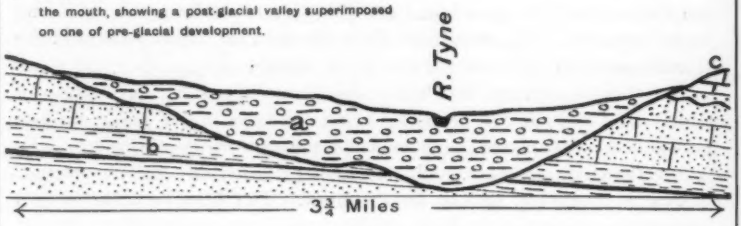
Another interesting feature of the new streams is the manner in which some of them are developed along the sides of the partly masked pre-Glacial valleys, and have eroded their new courses through rock rather than boulder clay. This is most probably due to the original surface of the drift having been convex. The best example of this phenomenon is that of the Wear, which from Durham to Chester-le-Street flows along the eastern edge of the "Wash," its wide and deep pre-Glacial course. (17)

The present trend of many of the rivers of Northumberland and Durham differs from that of the earlier cycle. In their higher reaches the new watercourses correspond with those of the former period, but in their lower portions, deviations of considerable moment have occurred. The present upper Wear valley is superimposed on that of the old one as far as Durham, but from that city this river keeps for miles along the side of the "Wash," and finally has developed a new track during the recent period from Chester-le-Street to the sea, breaching the Permian escarpment on its way. The new valley has been denuded since the formation of the raised beaches of the district, which will be discussed later. The Tyne follows the direction of its old path, only deviating from it at Walker and one or two other places, while farther north the courses of the Blyth, Wansbeck, and lower Coquet are new, and the "Sleekburn" and "Druridge" valleys of a former epoch are drowned beneath the drift. Of smaller streams of post-Glacial origin, the Team, which flows over the surface of the glacial deposits along the "Wash," the Don, the Chevington and Seaton Burns are examples. The larger tributary valleys of the Tyne and Wear, such as the East and West Allen, the Derwent, the Rookhope Burn, and the Browney, existed in the earlier cycle of river development, while many of the smaller belong to the later era, as the Newburn and Haltwhistle Burn. In both the present and former eras some obsequent or "anti-dip" streams have flowed into the Wear between Bishop Auckland and Chester-le-Street from the Permian escarpment.

There are five distinct types of valley in the north-eastern counties. The first, of which the Tyne is the best example, is where the post-Glacial river-course, with its broad alluvial flats of reassorted drift, is superimposed on the wide depressed one of the earlier epoch of denudation. The most clearly defined instance of the second is that of the Wear between Durham and Chester-le-Street, where the valley of later development has been eroded through rock along the side of the "Wash" of the former epoch. The third and fourth are entirely of post-glacial origin, and have been denuded since the formation of the

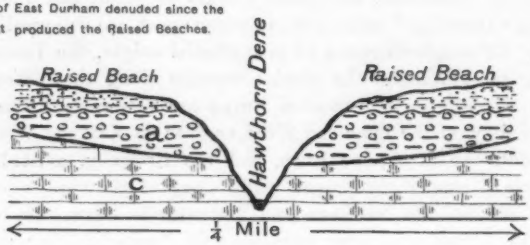
Sections across the principal types of valleys in Northumberland and Durham.

1.—Section across the River Tyne about two miles from the mouth, showing a post-glacial valley superimposed on one of pre-glacial development.

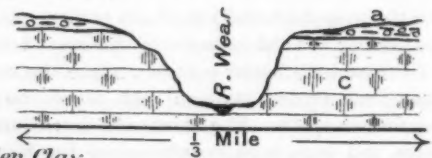


2.—Section across the "Wash" and River Wear, showing a post-glacial valley developed through rock along the side of a deep pre-glacial one, now filled with superficial deposits.

3.—"Dene" of East Durham denuded since the uplift that produced the Raised Beaches.



4.—Section across the Wear, showing a post-glacial valley eroded through rock and boulder clay. This type is also later than the raised beaches, but its relation to them cannot be so clearly traced.



a = *Boulder Clay.*
b = *Coal Measures.*
c = *Magnesian Limestone.*

raised beaches, being, therefore, of very recent formation. The deep gorge-like "denes" of the Magnesian Limestone area have the beaches exposed on either side of their flanks, and have been denuded rapidly through raised beach, drift, and rock as the coastal region emerged from the sea. The valleys of the Wansbeck and the lower Wear are similar in formation, and have been cut through the superficial deposits down into the rock, but their relation to the raised beaches is not so clear as in the third type; they are, however, of exactly similar origin. The last class is that of the dry valleys or "slacks" of the two counties. Some are pre-Glacial valleys—as the Hopes of the Permian area of east Durham—

DRY SLACK, HUMBLEDON HEUGH, CHEVIOTS.
(*Dr. J. A. Smythe, photo.*)

which have been unfilled by drift; others are the overflow channels of glacier lakes, as the Beldon Cleugh near Blanchland, and the channel across Humbledon Heugh (Cheviots); while others, as the dry slacks, which can be observed near Newcastle, whether cut through drift entirely or through it into the rock, were possibly formed when the ice was finally melting from certain areas, and the water was being dammed back by the main iceflows, which had not as yet finally retreated. Prof. Lebour suggested, some thirty years ago, that the old Northumbrian word "swire" should be given to the deep-cut, narrow dry slacks. (18) This word "swire," or "swyre," is defined as the hollow or defile near the summit of a hill. Some such word, if adopted

to include all kinds of slacks and dry valleys, would prove exceedingly useful.

The valleys of post-Glacial origin, of which the Wansbeck is a good example, are narrow and gorge-like where they have been denuded through rock, and are thus clearly differentiated from those of the earlier epoch, whose sides slope down gently to the "thalweg." The latter bear evidence to the protracted action of the forces of sub-aërial denudation, while the former have been carved rapidly, and atmospheric and other agents of surface waste have not broadened and widened them to any considerable extent. The valleys of the two cycles are distinct, and the outlets of the rivers flowing in them are also quite different in character; thus the mouths of the superimposed valleys of the Tyne and Tees are broad, and have a wide area of flat land on either side of them, while those of the post-Glacial rivers of the Wear and Wansbeck are narrow. This has had a considerable influence on the commercial development of these rivers. The premier position of the Tyne depends on the fact that it flows in a superimposed valley; thus its haughs, on which its towns, villages, and shipyards are built, are broad, and extend for miles along its entire lower course, while its mouth is wide and of easy approach. The haughs of the Wear do not reach to its narrow mouth, and its sides rise steeply from the waterway.

The geographical position and commercial importance of Newcastle is due to the broad, flat, superimposed valleys of the Tyne, Derwent, and Team converging there. It is also of easy access from the boulder clay flats of Cleadon and Fulwell. All the railways that enter Newcastle have been constructed without meeting with any important physical barrier—no tunnels and few cuttings have had to be made. The main roads running from that city are also of easy gradient, with the exception of those that climb the northern and southern flanks of the pre-glacial rock-surface. On the other hand, the railways that enter Sunderland have met with physical obstacles due to the position of the Permian escarpment and the later development of the Wear valley. They have all had to pass through cuttings or tunnels.

Another important effect of the Glacial period was that nearly the whole of the country was clothed in a mantle of drift, which has rendered the dependence of the drainage upon the geological structure much less pronounced to-day than it was before the era of glaciation. The surface deposits lie thickest along the ancient "washes," reaching a maximum proved thickness of 230 feet at Newton Hall, Framwellgate, 2 miles north of Durham city, in the valley of the Wear. On the higher ground some of the escarpments rise like islands from beneath the cloak of superficial deposits, and in Northumberland especially, on account of the ease with which water could be obtained at these places, this has had considerable influence in determining the position of the minor places of settlement. Many of the villages of Northumberland

Reduced Geological Survey Drift Map showing the masses of sandstone (black) rising above the drift. The villages of Earsdon, Backworth, Killingworth, Whitley, &c, are built on such outcrops.

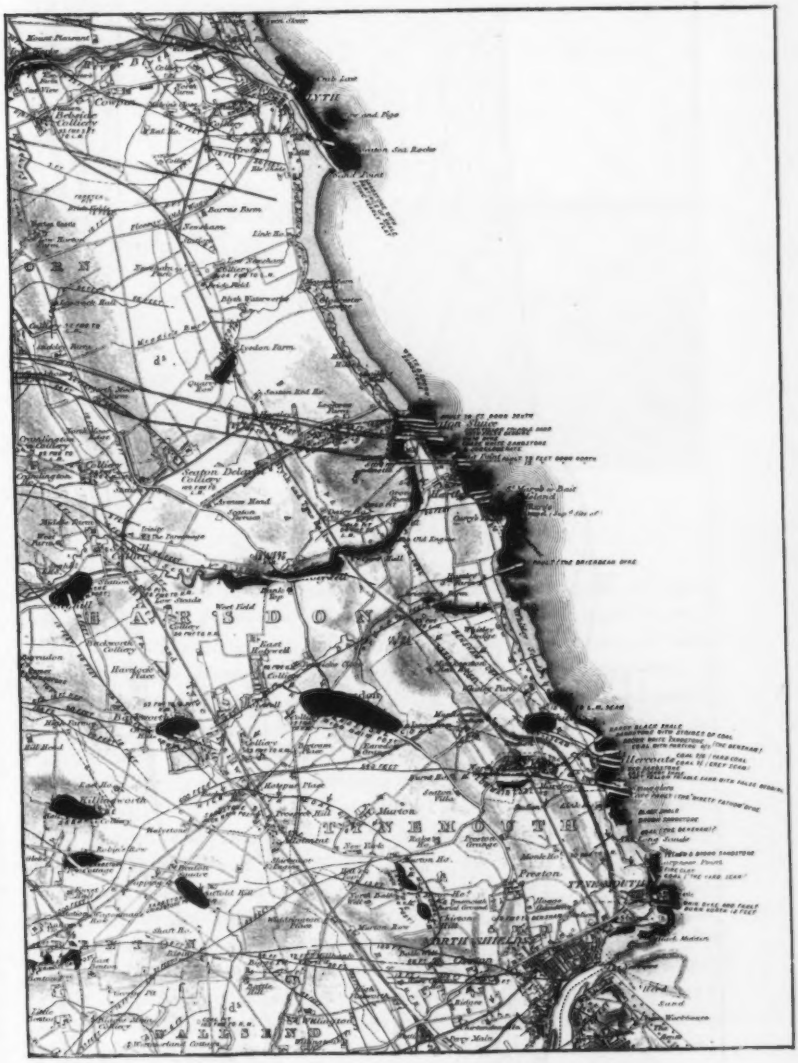


Fig. 1.—Section across one of the outcrops of sandstone which rise above the drift. The earliest settlements in Eastern Northumberland were built on such, due to the ease with which water could be obtained at the junction of the sandstone and drift

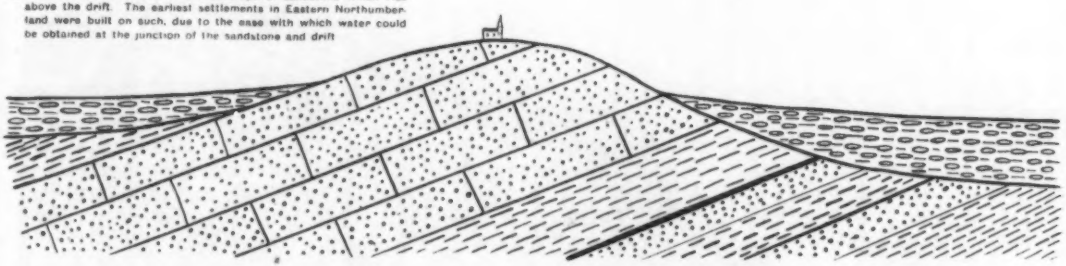
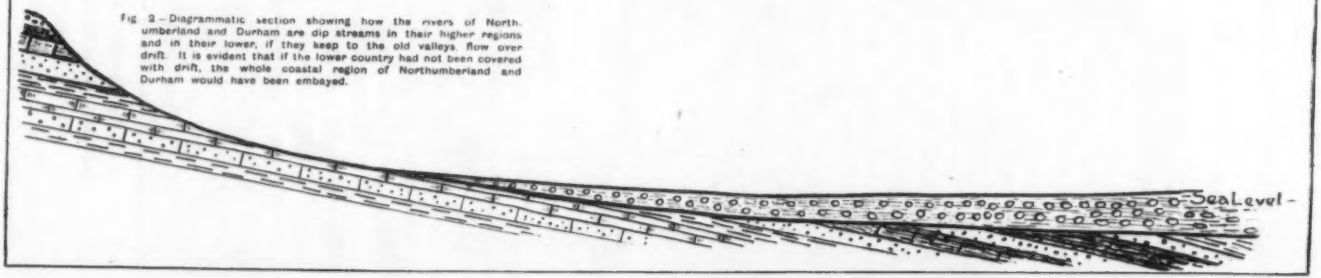


Fig. 2.—Diagrammatic section showing how the rivers of Northumberland and Durham are dip streams in their higher regions and in their lower, if they keep to the old valleys, flow over drift. It is evident that if the lower country had not been covered with drift, the whole coastal region of Northumberland and Durham would have been embayed.



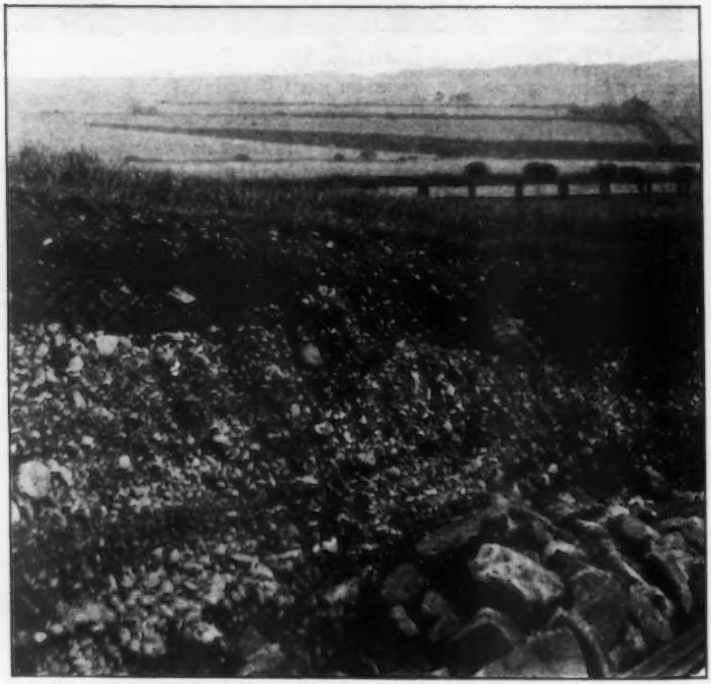
WHITBURN BAY.
(*H. Mitchell, photo.*)

(especially those with the syllable "ing" in their names) are, as Topley pointed out many years ago, old settlements, and either stand on sand and gravel hillocks lying on the boulder clay, or on exposures of sandstone which rise above the uniform level of the surface formations. A large number of the pit villages, which are in many cases merely enlargements of the ancient settlements, belong to the latter class, *e.g.* Killingworth, Widdrington, and Earsdon. The sandstone outcrops are doubtless escarpments, whose features are to a very large extent masked. Over the whole of the two north-eastern counties parts of, and in some cases, entire escarpments lie buried beneath the drift, and doubtless many minor valleys of the earlier epoch are entirely filled up and obliterated as surface features.

Where the pre-Glacial valleys debouch into the sea, the boulder clay which fills them has been denuded more quickly than the rock on either side, and in consequence many wide sweeping sandy bays have been formed. The principal are Druridge and Whitburn Bays, and those at the mouths of the Tyne and the Tees. They form a distinct feature of the north-eastern coast.

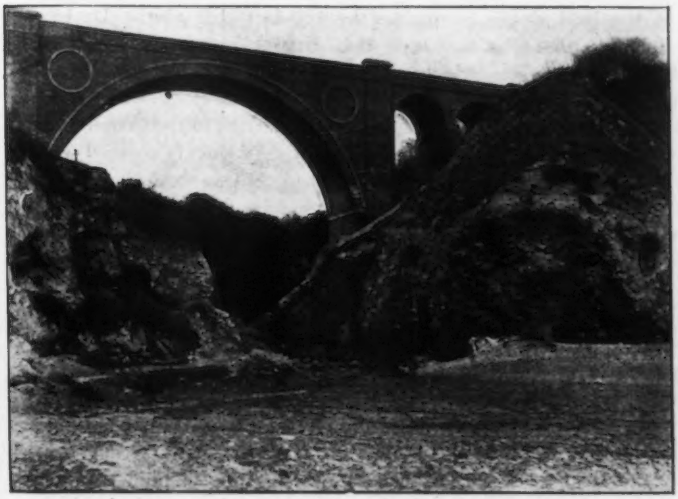
An influential factor in the development of the physiographical features of the two northern counties was the submergence of the eastern coast to a depth of at least 150 feet. Raised beaches reaching this maximum elevation have been observed and traced for many miles

in Northumberland and Durham. They rest in some cases on the rock and in other cases on boulder clay, and are largely formed of materials chiefly derived from the latter deposit, and therefore bear evidence to a submergence of the coastal region since the Ice age. The highest with its associated cliff and sea caves is or has been exposed, at about 150 feet above sea-level on Cleadon, (19) Fulwell, (20) and Tunstall Hills, and in the railway cutting near Dawdon Colliery along the new line between Seaham Harbour and Castle Eden. The next is the 100-feet raised beach running round Cleadon Hills. It is at present exposed in the two gravel and sand pits to the west of Cleadon village, and was exposed in 1878 at the Whitburn Lizards on the eastern side of the same hills; (21) it is observable near Tynemouth, (22) and along the coast to the south of Seaham Harbour as far as Castle Eden Dene. (23) A much lower one is traceable on the top of the cliff north of Howick Burn to the south of Cullernose Point; (24) and 50 miles further south a raised beach occurs near Saltburn at an elevation of 30 feet. (25) There are many peculiarities in these exposures and



150-FEET RAISED BEACH ON FULWELL HILLS, NEAR SUNDERLAND.
(*D. W., photo.*)

their relation to one another, which cannot be discussed in this general paper. The highest two of these raised beaches have been splendidly preserved on the Permian area of County Durham, because the pebbles have been cemented together to form a conglomerate by calcium carbonate derived from the Magnesian Limestone, and it is possible that the reason they cannot be traced very far inland is, that the materials forming them were never cemented, and thus they were unable to withstand subsequent denudation. When the highest beach was being formed, all the lower parts of the eastern area of the two counties were submerged, the lower reaches of the rivers were arms of the sea, and some portions of the higher lands lying near the coast, as



HAWTHORN DENE, A GORGE-LIKE POST-GLACIAL VALLEY CUT SINCE THE FORMATION OF THE RAISED BEACHES.
(*D. W., photo.*)

Cleadon Hills, were islands. It was probably during this period that the upper parts of the boulder clay lying on the lower ground were washed up and redeposited, the prismatic clay—the brick clay of the coastal area—being produced by the drying up of the saturated deposits. All traces of the ridges and mounds, which form such a distinct feature of the boulder clay in other areas, and which probably existed on the lower parts of Northumberland and Durham, as they do still on the higher, were removed, and the whole of the region lying along the coast was levelled out, and the upper parts of the boulder clay rendered less stiff. This submergence has had a considerable influence on the commercial development of the district, and the subsequent elevation of

the land, by giving new power to the forces of sub-aërial denudation, has had a marked effect on the physical features of the two north-eastern counties. It has been already shown that the present rivers of these counties are post-Glacial in origin; they have either superimposed valleys on the ancient pre-Glacial valleys, or are cutting entirely new courses, which in their lower reaches have been developed since the uplift that produced the raised beaches.

This recent period of denudation has had most effect on the triangular portion of the country lying between the edge of the Permian outcrop and the sea, the entire rock surface of which is composed of Magnesian Limestone. The escarpment rises sharply from the level country to the west, reaching a height of from 400 to 600 feet, and from it the land slopes gently to the 100-foot cliff of the Durham coast. Before the Glacial period this district had been carved by numerous small streams, which, when the district was more elevated, were all tributaries of the pre-Glacial Tees. As the steep but not very elevated escarpment seems to have acted as a barrier to the iceflow from the west and north-west, this country is not very thickly covered with drift, and hence many of the earlier-formed valleys—called in some cases "hopes," as Tunstall Hope—although now dry, form a distinct feature of the surface of east Durham. Since the formation of the raised beaches and the associated marine terrace, which are clearly observable on the Durham coast south of Seaham Harbour, the country has had a new drainage superimposed on the old, and many deep, gorge-like valleys—designated "denes," as Ryhope, Hawthorn, and Castle Eden Denes—have been eroded.

Along the coast of Northumberland and Durham submerged forests have been observed at North Sunderland, Howick Burn, Whitburn Bay, and Hartlepool, (26) and these seem to mark a slight recent submergence of the coastal region; but the effect of this in hindering the development of the streams of the recent period must have been exceedingly slight. Whether this movement is at present taking place in the area, it is impossible to assert; and although certain parts of the district appear to be sinking slightly—as was proved by T. W. Backhouse and Frank Caws to be the case in the neighbourhood of Sunderland (27)—such a lowering may be due to other causes than a general depression of north-east England.

Finally, it is certain that the present topography of Northumberland and Durham has been evolved gradually; the reproductive and destructive forces have, by their protracted action, produced the present configuration of Northumbria; and the results of these have influenced the commercial development, determined the position of the towns and villages, and regulated the lines of human movement within this clearly defined physiographical area.

After the paper:—

Dr. STRAHAN: I should like to say, in the first place, that although much of what Dr. Woolacott has put before us this afternoon is familiar to us from his paper in the *Quarterly Journal* of the Geological Society, it has been a great pleasure to hear his application of that information and its influence upon the situation of the towns brought out so clearly. Probably no one is better aware than Dr. Woolacott himself that such phenomena are not confined to this part of England. It is evident that the country, when freed from its great ice-burden, did not resume the same aspect which it had before. In many parts the rivers assumed different courses, and the physical features were greatly changed. The Mersey, for example, has been proved to be running in a post-Glacial channel, diverging from that which it occupied in pre-Glacial times. Just as these Durham rivers were filled up with drift, so were the former channels of the Mersey. The Tawe also, at Swansea, flows over a thickness of more than 150 feet of gravel; and so with many other rivers which I could enumerate. But further south it is possible to see what these valleys would have been like if they had not been choked up in this manner with gravel. Milford Haven, Plymouth Sound, and other branches of the sea wander far inland and enable the tide to penetrate into districts where the stranger would least expect to find it. One remark Dr. Woolacott made interested me greatly. He spoke of a small anticlinal fold—the Corbridge—as having determined the courses of certain rivers, and he also spoke of the courses of those rivers as having been determined in pre-Miocene times. Now, the evidence is clear that all our south country rivers have had their courses determined at a much later period than that. The sinking of the London syncline and the upheaval of the Wealden anticline, the sinking of the Hampshire syncline and the upheaval of the Isle of Wight anticline, directly determined the flow of those rivers. But in the Isle of Wight it is easy to determine the exact geological date at which those folds came into existence; they were certainly post-Oligocene, inasmuch as the Oligocene strata are involved in the folding, but they were certainly pre-Pliocene, inasmuch as the anticlines were upheaved before the Pliocene strata were spread over them. It follows that the river-system of the south country was initiated in post-Oligocene and pre-Pliocene times. I endeavoured, some years ago, to extend that theory into the south-west region, but in the absence of all Tertiary strata and of the chalk, it is exceedingly difficult to apply the test; in fact, it cannot be applied directly. I did not meet with any evidence bearing against the theory that the rivers, say, of South Wales and Devonshire, might have taken their origin at an equally late period, but I was unable to obtain confirmation of it. If Dr. Woolacott can throw any light on that problem, and show that the rivers of Northumberland and Durham were initiated by earth-folds at so late a period as those of the south country, he will have added a very interesting fact to the history of our English rivers. One point I should like to mention, and I am afraid it rather takes the form of criticism. Dr. Woolacott showed us some photographs of what he calls "raised beaches." I should like to know what was the evidence on which those deposits of sand and clay were classed as raised beaches. Of course I only judge from the photographs, but what I saw in them resembled so exactly the deposits of sand, gravel, and boulder clay with which I am familiar in many parts of England, and which are indubitably Glacial and not raised beach, that I should like to ask what is the evidence that it was actually the sea which formed the deposits to which he referred. Before sitting down I wish to congratulate Dr. Woolacott on the lucidity with which he has put before us a somewhat technical subject.

Mr. LAMPLUGH: Dr. Strahan has already raised the main question that I should

like to put to Dr. Woolacott, namely, What is the evidence on which he depends in recognizing the high-level terraces as marine beaches? I have myself examined the coast from the Humber to the Tees, for the purpose of determining whether there has been submergence during or since glacial times, and could find no evidence for it. The so-called beach at Saltburn at 30 feet above sea-level, to which Dr. Woolacott refers, is in such a position that it is quite unlikely to be a post-glacial sea-margin. A depression of the kind supposed would have submerged a large part of the Tees valley, and also many wide areas of low land farther south in East Yorkshire, yet in these places there is no sign of marine agency at this level since the deposition of the drift. It is true that there are fringes of sand and gravel deposited by water in this country, but these were probably all accumulated at the margin of the ice-sheet, or in bodies of fresh water pent in between the ice-sheet and the land. If there has been a post-glacial submergence to the extent of 150 feet in the area described by Dr. Woolacott, the absence of evidence for any such submergence south of the Tees raises a very important problem. Therefore, unless the evidence is very clear, the author should be especially cautious in speaking of gravels and clays as marine, since much depends upon it.

With regard to the evolution of valleys, a question in which geographers and geologists join hands, the geologist usually finds it comparatively easy to picture to himself the pre-glacial valley-system, even where it has been greatly modified, as in the present case, by masses of drift; but when he goes back into Tertiary times, then he goes into the region of speculation and doubt. We have, in fact, no good basis yet for appreciating how much re-shaping of the land has taken place since, say, early Miocene times. The attempt to trace the earlier history of the East Yorkshire valleys, to which reference has been made by Dr. Woolacott, is regarded, by those who know the country, as so highly hypothetical that it scarcely requires consideration. If we at present concentrate attention upon the pre-glacial topography in any district, we shall, I think, do better than if we attempt immediately to carry back our ideas of the ancient topography so far that all is involved in mist and hypothesis. I feel this the more keenly because so fully in sympathy with the renewed interest now aroused in these studies, that I should be sorry to see the subject discredited by any hasty and premature theorizing. We shall in time get a surer grip of these problems, and can afford to be patient. Therefore I would ask Dr. Woolacott, who has made such an excellent beginning in these studies, to go warily when he gets away from his pre-glacial valleys and deals with the shape of the land in Miocene times.

Mr. MACKINDER: I need hardly say that I have listened to this paper with a great sense of congratulation to the writer, but naturally from a slightly different point of view from that taken by the two gentlemen who have already spoken. They are experts as to the geological evidence, and I am looking rather to the geographical application of the evidence established. What I would venture to say at the present moment is something connected with the first paragraph of this paper, because method in geography is just now of some importance. Of course, for purposes of investigation you cannot cut a subject sharply into parts, nor can you divide one subject abruptly from another. For the purposes of investigation the limits of subjects are immaterial. But from the point of view of academic study, these matters of organization have a certain significance. At the present moment in various universities syllabuses of geographical study are being settled, and they will determine in no small degree the fate of the present effort to give to geographical education a university status. Now, I notice that Dr. Woolacott divides the joint material of geology and geography into two sections. I would venture to suggest, as a general guidance for the drafting of these syllabuses,

that a division into three of that joint material would be better. I may cite, as supporting my view, the well-known statement in Sir Archibald Geikie's 'Text-book of Geology' that geology divides naturally into the study of the history of the rocks, and the study of the history of the present surface. To these two divisions must be added as a third what stands as Dr. Woolacott's second division, namely, the application to the problems of human distribution. It is, of course, quite true that when you come to the glacial epoch in such a country as ours, sharpness of definition between the first and second divisions is no longer possible, and I suppose that the geographer, no less than the geologist, must consider both the pre-glacial surface and the present surface. But with that slight blur on the sharpness of definition, and with every admission that the definition must not be pressed too far, I think that for the purpose of classification and for the drafting of syllabuses which are to guide study, the triple division to which I have referred is important. The second division is common ground to the geologist and the geographer. But you will not get the geographical student who approaches geography with a view to its humane applications to give much study to the first. Unless you detach it, there is great danger that he will jettison also the second, and this would be fatal to any sound knowledge of those physical features on which humane geography is based. Such a paper as we have had to-day is of the greatest value, because it discusses a limited district thoroughly from the point of view of the features of the present surface.

When Dr. Woolacott came to his applications of these physical facts, one felt, of course, that he was considering only one set of the causes which the geographer must take into account. For instance, he described Newcastle-on-Tyne as being placed at the junction of certain valleys of a certain character, and then he contrasted it with the position of Sunderland. Then he went on to point out that the railways had access to Newcastle more easily than to Sunderland as the consequence of these facts. But, of course, this would not account for the greater significance of Newcastle, since both that town and Sunderland existed before the railways, and the railways were made to these towns just because they did already exist. The towns rose as market centres, dependent on the productivity of the areas around, and larger considerations determining the lie of the roads from distant centres account for the greater importance of Newcastle than Sunderland. I do not for a moment suppose that Dr. Woolacott intended to exhaust the causes, and I merely wish to point out that there are other great groups of causes to be considered by the geographer in addition to the geological, as, for instance, the economic and strategic. What we require at the present moment is that persons who are equipped from the geological point of view like Dr. Woolacott should go on to equip themselves from the historical point of view, and then should give us, as I feel sure he could most admirably, the complete geographical picture of some such region as he has considered. I am convinced, from all that I have now had to do with geographical study, that two men working together will never satisfactorily accomplish these syntheses, and that it is absolutely essential that each district should be treated by one man working with a double equipment.

Mr. Chisholm: There is one thing for which, I think, we must feel indebted to Dr. Woolacott, and that is, that in considering the region dealt with this afternoon, he has given us an account of the recent geology. For the most part, geological maps and geological treatises consider merely what they call the solid geology, and very often the solid geology is just that part which leaves out of account what is of most interest to geographers. I remember, as an illustration of that, that when I was taking a holiday I thought it would add to the interest of my holiday to get a geological map of the district, and, having obtained the proper sheet of the geological

map on the scale of 4 miles to the inch, I was talking to a resident, and said, "Now, this village stands upon chalk." "Excuse me, sir," he said; "it stands upon gravel." On looking about me, I found he was right; it did stand upon gravel, and upon a very great thickness of gravel. And what I found was that the geology that actually gave significance to the physical features was the drift, which was altogether omitted from this map. And now I feel tempted to make one or two remarks that have suggested themselves to me in reading this first paragraph of the paper, but which I had not intended to make until Mr. Mackinder touched upon that part of the paper. I thought the distinction between the point of view of the geographer and the geologist was really so large a subject that it was hardly possible to enter upon it in an afternoon meeting like this, but, as the question has been raised, I feel disposed to make some remarks upon it. On this subject I am, to a large extent, but not wholly at one with Mr. Mackinder. It seems to me that there is a very clear, sharp, and absolutely decisive line of division between geology and geography, a line of division not determining the difference in the subject-matter, but a difference in the point of view. Mr. Mackinder has stated that Sir Archibald Geikie makes a twofold division of the subject-matter, but it is also to be noted that he also gives a definition of geology which makes the aim and nature of the geologist's inquiry perfectly clear. Sir Archibald Geikie states that geology is the science which inquires into the history of the Earth's crust. Well, that is very clear, and if that is the aim of geology, every investigation that deals with the history of the Earth's crust, even if it be the very latest changes that have taken place in the course of a river, belongs to the sphere of geology. In his opening paragraph, Dr. Woolacott says that the bearing on humanity of the Earth's crust, its places of settlement and lines of movement, is chiefly the work of the geographer. Now, though I would not admit that the consideration merely of the geological structure upon human life forms the entire field of the geographer, yet I can accept this statement as at least indicating the function of the geographer. The geographer as is here indicated considers effects. The study of the geographer is the study of the influence of local conditions and place relations, and I think, in giving that definition, I have included everything Mr. Mackinder has just indicated as among the matters that had been—I won't say overlooked—but passed over by Dr. Woolacott in considering the geographical influences on the part of England that we have been studying this afternoon. Mr. Mackinder said that, in addition to a precise, minute local study, we must take also a broad view. Well, that is what I mean by describing geography as including the study of place relations. These are included under a broad view of the study of any particular place, such as Newcastle or Sunderland; and then, taking that broad view, we must bear in mind the fact that influence of place relations varies at different times. To give an illustration of points of some little interest in connection with the geography of Northumberland that might have suggested themselves to Dr. Woolacott had he not confined himself solely to the influence of geological conditions, I might refer to a valley in Northumberland that has been a great highway for a very much longer period than one of the routes to which he has referred in his paper. He spoke of the railway going from the Tyne valley into Scotland and then up Liddisdale. That is quite a new route. The old Roman road, and the road which was afterwards so important through a long period of Scottish history, went over a broader part of the Cheviots. Now, the difference in the line of these two routes is a matter of some little geographical interest. There are parallels to it in various parts of the world, but parallels that are altogether independent of geology. The interest connected with this difference, from the geographical point of view, is this—that the old road before the days of railways naturally took the easiest gradient up to the most convenient

part to be crossed, and then went downwards by an equally easy gradient on the other side, if it could get that easy gradient. The result of that is that a broad part of the mountains and hills to be crossed was naturally chosen, but railways may run for a long distance into the hills by valleys with still easier grades, and ultimately come to a narrower part of the hills where a tunnel can be made. That is what we have in the present railway route of the Mont Cenis tunnel as compared with the old Mont Cenis road; in the first railway route between Genoa and the northern plains of Italy as compared with the route over the Bocchetta pass; and in the railway route between Bologna and Florence as compared with the old road across the pass of La Futa, and in other cases. But these things I mention solely by way of illustrating what I understand to be the distinction between the geologist's and the geographer's point of view, fully recognizing that they did not fall within the scope of Dr. Woolacott's paper, as to the value and interest of which I am quite at one with the previous speakers.

The CHAIRMAN: Would any other gentleman wish to join the discussion? If not, perhaps Dr. Woolacott will reply briefly to the points that have been raised.

Dr. WOOLACOTT: Allow me, first of all, to thank you for the discussion. The paper was never meant to be an exhaustive study of the geography of the two counties; it was simply an idea of mine to give a physiographical basis to the geography of the counties. With reference to Dr. Strahan's remarks, I do not think it is possible to fix the time, so far as one can gather from any of the features exposed, of the Corbridge Fold. With regard to the raised beaches, I may say they have been recognized from at least 1878. Sea-caves were found at the time of the first exposure, and there is an old sea-cliff found at the present time. The sea-caves were distinctly cut out, and several animal remains were found in them. Shells occur in the gravels, although I have never found any perfect ones, but they have been, and I have found several fragmentary portions similar to those found at the present day. Numerous specimens of *Patella*, *Littorina*, and *Cyprina* have been collected.

Mr. LAMPLUGH: Mr. Cowper Reed described a gravel with shells in it.

Mr. WOOLACOTT: I am quite aware of that. I also know there are glacial gravels at a higher level, covering certain portions of Durham and Northumberland, but the line of these marine gravels can be distinctly traced for some miles along the coast. The rocks on which they rest appear to be distinctly water-worn, and there is a marine terrace running for some distance along the coast. I think most of the geologists of the north of England, the local workers at any rate, have recognized these raised beaches. All I have done is to endeavour to trace them from one point to another. I quite agree with you that it is a most important matter; but there is one point that is rather in favour of their being raised beaches, and that is, that there is a distinct change in the character of the country above the 150-feet contour-line; beneath it the drift is quite level, while above, the ridges and mounds are still preserved.

Mr. LAMPLUGH: That is so also with glacial drift deposited in lakes or currents of fresh water. Have you been able to find the beach farther south?

Dr. WOOLACOTT: I do not know of it further south. Between the Tees and Flamborough, it may have been removed by denudation. The Geological Survey recognized these raised beaches. I may say the only reason I mentioned the course of the Tees across the Cleveland hills was in order to make the paper as complete as possible. I do not recognize that there is any evidence proving the Wear to have been a tributary of the Tees. Of course, one must take into account the work of other workers. I think I have answered Mr. Mackinder and Mr. Chisholm regarding my idea of the paper, that it was simply looking at geography

from the physiographical standpoint, being an endeavour to show how certain features of Northumberland and Durham had influenced the commercial development and fixed the places of settlement. A "wash" is simply a valley of preglacial development now filled with drift. "Slack" is either a dry valley, or a valley in which there is a small stream which could not have caused the valley—a stream which is not adjusted to the valley, and in Northumberland and Durham have been caused in several ways. "Haugh" I regard as the river flats. In conclusion, I desire to thank you for your attention and for your criticisms.

The CHAIRMAN (Major C. F. CLOSE): I am afraid I can add nothing to the discussion to-night, the subject being rather too technical for me to follow with advantage. But I may say that I have derived as much instruction from the discussion (which I consider to be one of the best we have ever had) as from the very carefully prepared and well-illustrated paper of Dr. Woolacott. I will ask you to join me in a cordial vote of thanks to him for the trouble he has taken and the instruction he has given us.

Dr. HERBERTSON, who had to leave before the close of the discussion, made the following communication:—

He thought that it was part of the work of the Research Department to secure such papers as this, in which Dr. Woolacott gave a general summary of his own researches and those of other geologists on the evolution of a definite region. He was very much impressed with the clear way in which the facts and explanations had been presented, and by the admirable diagrams and views which had been thrown on the screen, most of which he hoped would appear when the paper was published in the *Journal*.

He agreed with Mr. Lamplugh's contention that the most satisfactory way of tracing the evolution of present land forms was to pass step by step from the present into the past rather than the other way. He also advocated a much more general use of the comparative method—the selection of examples of stages of development as they are best seen in different and maybe widely severed districts which are comparable in structure and in climate.

Dr. Woolacott had paved the way for a rational geographical treatment of the morphology of Northumberland and Durham; he had prepared the raw material in such a way that the geographer could use it. But it was necessary to point out, as Mr. Mackinder and Mr. Chisholm had done, that the function of the geographer was more than to trace the influence of configuration on mankind. After their remarks, he need only add that he hoped that Dr. Woolacott himself might take up the study of the geography of this north-eastern region of England, and give them at no distant date the results of his investigations.

There was another point in the printed paper to which he would like to refer—viz. the suggestion that swire or swyre should be used as a technical term for all dry valleys. At the present, when terminology was not yet fixed, it was highly desirable that definite rules should be adopted. As far as possible, terms for the larger classes of geographical phenomena should be selected so as to be sufficiently intelligible to the ordinary person, while conveying precise ideas to the specialist. For the subdivisions, which were of interest mainly to the specialist, this was not so important, yet even here intelligibility should be considered. Hence he would prefer to use the term "dry valley" for the general class, and such terms as "slack, swyre, bottom," etc., for the varieties of dry valleys.

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BATHYMETRICAL SURVEY OF THE FRESH-WATER LOCHS OF SCOTLAND.*

Under the Direction of Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., etc., and LAURENCE PULLAR, F.R.S.E.

Part XIII.—Lochs of the Ness Basin.

FIRST PART.

The basin of the river Ness is one of the most important of Scottish river-basins, not so much on account of the area drained, which is small when compared with the areas drained by the Tay, Tweed, Clyde, and Spey, for instance, but because it includes within its boundaries the largest body of fresh water in Scotland (Loch Ness), as well as several other large lochs and numerous small ones. The basin extends from the mouth of the river Ness, at the junction of the inner Moray Firth with the Beauly Firth, in lat. 57° 30′ N. to lat. 57° N., south of Loch Quoich, and from long. 5° 30′ W., west of Loch Quoich, to long. 4° 10′ W., south-east of Inverness. The total area, as measured with the planimeter on the 1-inch Ordnance Survey maps, is about 722 square miles, and of this by far the larger portion drains into Loch Ness, for the area draining into the river Ness, and into Loch Ashie which flows directly

* Maps, p. 116. The admirable maps which accompany the present and two succeeding papers (the last of the series) have been presented by Sir John Murray and Mr. Laurence Pullar, and it is thus due to their liberality that we are able to publish them free of any cost to the Society.—President R.G.S.

into the river Ness, is only about 36 square miles. With the exception of Loch Ashie, the superfluent waters from all the lochs within the basin find their way into Loch Ness, so that the total area draining into Loch Ness is about 686 square miles. The area drained by the tributary lochs, to be dealt with in subsequent papers, is about 354 square miles, leaving about 332 square miles draining directly into Loch Ness, independent of the other lochs.

The principal river-systems within the basin lie to the west of Loch Ness, viz. the Enrick, which flows through Glen Urquhart into Loch

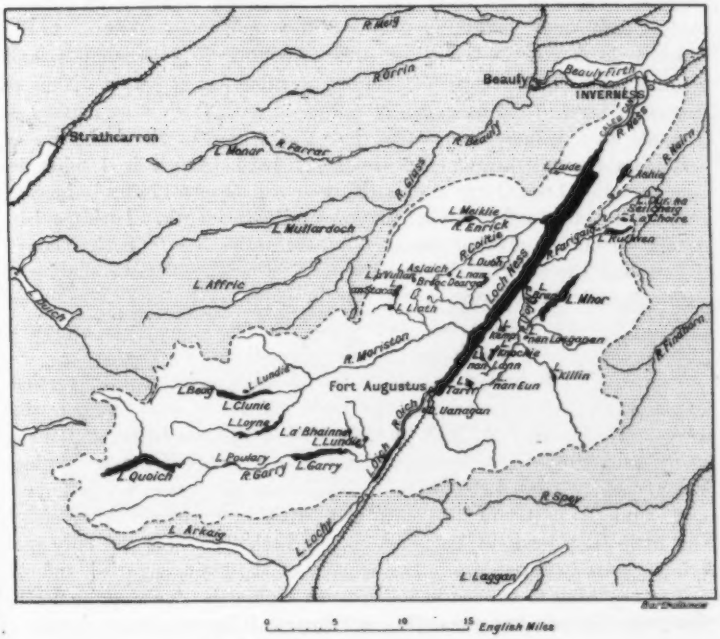


FIG. 1.—INDEX MAP OF THE NESS BASIN.

Ness at Urquhart Bay, where it is joined by the shorter river Coiltie; the Moriston, with its tributaries the Clunie and the Loyne, which flows through Glen Moriston into Loch Ness at Invermoriston; the Garry, with its tributaries the Quoich and the Kingie, which flows through Glen Garry into Loch Oich at Invergarry, and thence by the Oich into the head of Loch Ness at Fort Augustus. To the south of Loch Ness lies the Tarff, also entering Loch Ness near Fort Augustus; and to the east lie the Foyers, with its tributaries the Breinag and the Fechlin, which flows into Loch Ness at Foyers, and the Farigaig which

enters Loch Ness at Inverfarigaig. Finally, to the north-east of Loch Ness lies the Allt Mor (or Big Burn), draining Loch Ashie, which flows into the river Ness 2 or 3 miles below Inverness, while the river Ness, after issuing from Loch Dochfour, at the northern end of Loch Ness, follows a winding course of about 6 miles, and pours its waters into the Moray Firth. Besides these, there are many shorter streams and burns flowing directly into Loch Ness, or into the tributary rivers or lochs.

As will be seen from the summary table, the staff of the Lake Survey sounded thirty-three lochs within the Ness basin, while a number of small lochs could not be surveyed for lack of facilities. These lochs vary in size, from the little Loch nan Losganan, covering an area of only 7 acres, and containing only a million cubic feet of water, to the mighty Loch Ness covering an area exceeding 20 square miles, and containing many thousands of millions of cubic feet of water. None of the other lochs in the basin can be compared with Loch Ness, neither as regards area, volume, nor depth, but still a few of the lochs are of considerable importance. For instance, Loch Quoich is 7 miles in length, while Loch Garry and Loch Mhor are nearly 5 miles in length, and Loch Clunie and Loch Oich exceed 4 miles in length. Loch Quoich, again, covers an area of nearly 3 square miles, while Lochs Garry, Mhor, and Clunie exceed a square mile in area. Two of the lochs (Quoich and Garry) exceed 200 feet in depth, and three other lochs (Oich, Clunie, and nan Lann) exceed 100 feet in depth, while no fewer than twelve others include depths exceeding 50 feet.

The basin lies almost entirely in Inverness-shire, but a small portion of Ross-shire extends within the basin on its western border, the boundary-line running along the centre of West Loch Loyne and for a short distance along the centre of East Loch Loyne, and thence turning northward it crosses Loch Clunie in its central part; thus Lochs Loyne and Clunie lie partly in Ross-shire and partly in Inverness-shire, while the little Loch Beag, at the west end of Loch Clunie, is the only one lying wholly in Ross-shire. The scenery of the basin is varied, and as fine as anything to be seen in the Scottish highlands: towards the north the ground is low, but proceeding southwards it becomes more elevated, culminating on the south-western borders in several giant peaks exceeding 3000 feet in height, and on the south-eastern borders in mountains slightly less elevated. The district is a veritable sportsman's paradise, the deer-forests, grouse-moors, and fishings (both in river and loch) being of the best. Trout abound in nearly every loch, with salmon and *salmo ferox* in some of the larger lochs, and char in some of the smaller lochs lying to the east of Loch Ness; the fishing in most of the lochs is preserved.

Loch Ness (see Plates I. and II.).—Loch Ness formed the subject of discussion at a meeting of the Research Department of the Royal Geographical Society on January 18, 1904, and preliminary notes on the bathymetry, temperatures, and seiches were published in the *Journal* in

October, 1904.* Since then many temperature and seiche observations and supplementary soundings have been taken, and the preliminary measurements and calculations have been carefully revised, the final results being given in this paper. Loch Ness is one of the best known of the larger Scottish lochs, since it forms a considerable part (nearly one-half) of the waterway known as the Caledonian canal, which occupies the great glen running in a north-east and south-west direction from the Moray Firth on the east coast of Scotland to Loch Linnhe on the west coast, thus cutting Scotland into two portions. Through the Caledonian canal thousands of visitors are carried each season on the

FIG. 2.—GENERAL VIEW OF LOCH NESS FROM BORLUM, NEAR FORT AUGUSTUS, LOOKING NORTH-EAST.

(*Photo by Mr. G. West. From 'Proc. Roy. Soc. Edin.,' by permission of the Council.*)

route between Inverness and Fort William, and the splendid scenery of the canal and surrounding district has furnished a theme for many pens. The absence of islands in Loch Ness is a striking characteristic, and gives a touch of monotony to the grand and sombre scene, as one sails up or down; the little Cherry island, lying at the opening of Inchnacardoch bay near the head of the loch, is invisible except at close quarters. Castle Urquhart, on its rocky headland at the south side of Urquhart bay, forms a picturesque and noteworthy landmark.

In his journey to the Western islands of Scotland in the autumn of 1773, Dr. Johnston travelled along the shores of Loch Ness, which, he

* *Geogr. Journ.*, vol. 24, p. 429.

says, is in some places 140 fathoms deep, and he remarks further that "Natural philosophy is now one of the favourite studies of the Scottish nation, and Loch Ness well deserves to be diligently examined." After the lapse of 130 years this has been done, and it is proposed in this place to summarize the results obtained by the staff of the Lake Survey during their prolonged and "diligent examination" of Loch Ness.

The survey of Loch Ness was commenced on April 2, 1903, and by the end of that month the preliminary survey was completed, but subsequently, at various periods during the years 1903 and 1904, many additional lines of soundings and numerous isolated soundings were taken, some of them in connection with the work of collecting samples of the deposits from all parts of the loch, others in connection with the work of taking temperatures at various depths in different parts of the loch. The total number of soundings recorded is about 1700, but some of them have been omitted on the accompanying map to avoid overcrowding. On April 1, 1903, the level of the surface of the loch was determined from bench-marks as being 52·6 feet above the sea, and to this datum-level all soundings have been reduced. A levelling-staff was erected first at Fort Augustus, then at Invermoriston, Foyers, and Temple piers, and the height of the water on this staff was read daily during the progress of the survey, so that the variations in level from day to day, and the variations from the starting-point, were readily known. These staff readings showed that the water fell gradually but irregularly, and by April 15 it was 1 foot lower, and by the 18th it was $1\frac{1}{2}$ feet lower, than on April 1.

Loch Ness proper may be said to extend from the head of the loch at Fort Augustus to the narrows at Bona ferry, a distance of $22\frac{3}{4}$ miles following the axis of maximum depth. This figure is inferior to the length of Loch Awe ($25\frac{1}{2}$ miles), and slightly in excess of the length of Loch Lomond ($22\frac{3}{4}$ miles); if we regard the small basin of Loch Dochfour, which is continuous with Loch Ness at its northern end, as forming part of the loch, then the total length, from the exit of the river Ness to the head of the loch, is about $24\frac{1}{4}$ miles.

In this place it is proposed to include Loch Dochfour in dealing with Loch Ness; it is a basin about $1\frac{1}{2}$ miles in length, with a maximum depth of 50 feet in the wide central portion, whence it narrows towards the two ends, the southern narrows leading into Loch Ness, and the northern termination being divided into two branches, the eastern branch forming the river Ness, and the western branch the continuation of the canal. With a strong south-westerly wind there is a surface current from Loch Ness into Loch Dochfour through the narrows at Bona ferry, and, if long continued, the water becomes banked up in Loch Dochfour, and gives rise to a return current along the bottom into Loch Ness; with a strong wind from the north-east the surface current sets in the opposite direction, *i.e.* from Loch Dochfour into Loch Ness.

Cut off from the western margin of Loch Dochfour, by embankments carrying the towing-path for the canal, are two small basins, one called Abban water, having a maximum depth of 9 feet, the other without a distinctive name, having a maximum depth of 23 feet; they stand at the same level as Loch Dochfour, the water evidently percolating through the embankments.

Loch Ness may be said to be fairly uniform in breadth, though varying to some extent, but on the whole its shore-line is very regular when compared with other large lochs. The upper portion between Fort Augustus and Foyers for about 10 miles is under a mile in width,

FIG. 3.—INCHNACARDOCH BAY, LOCH NESS, SHOWING CHERRY ISLAND AND THE "HORSESHOE" IN THE DISTANCE.

(Photo by Mr. G. West. From 'Proc. Roy. Soc. Edin.,' by permission of the Council.)

except at the opening of Glen Moriston, where the breadth slightly exceeds a mile. The portion between Foyers and Castle Urquhart for about 5 miles is almost exactly a mile in width, while the lower portion between Castle Urquhart and Torr point for about 5 miles exceeds a mile in width. The widest part of the loch is at Urquhart bay, from the mouth of the river Enrick due east to the opposite shore, where the width is 2 miles. The portion of the loch from Torr point to Bona ferry for about 1½ miles varies in width from a half to a quarter of a mile, and the central portion of Loch Dochfour is about a quarter of a mile in width. The mean breadth of the entire loch is nine-tenths of a mile, or less than 4 per cent. of the length; a smaller percentage of

mean breadth to length has been recorded only in Loch Shiel and Loch Shin, with 2½ and 3 per cent. respectively.

The waters of Loch Ness cover an area of nearly 14,000 acres, or 21¾ square miles. Among the Scottish fresh-water lochs this is exceeded only by Loch Lomond, which has a superficial area of nearly 27½ square miles. As already stated, the area draining directly into Loch Ness is about 332 square miles, while its total drainage area, including the area draining into all the tributary lochs, is about 686 square miles—an area over thirty times greater than that of the loch.

The maximum depth observed by the Lake Survey staff in Loch Ness was 754 feet, about a mile due south of Castle Urquhart in the centre of the loch. A greater depth than this has been recorded in only one Scottish loch, viz. Loch Morar, which has a maximum depth of 1017 feet, and after Loch Ness come Loch Lomond and Loch Lochy, with maxima of 623 and 531 feet respectively.

The volume of water contained in Loch Ness is estimated at 263,000 millions of cubic feet, or 1¾ cubic miles. In no other Scottish loch does the bulk of water amount to a cubic mile, in fact Loch Ness contains about three times as much water as the two lochs which most nearly approach it in this respect, viz. Loch Lomond with 92,800 million cubic feet, and Loch Morar with 81,500 million cubic feet. The largest volume of water recorded by Dr. Mill among the lakes of the Cumberland district is only 12,250 million cubic feet. As far as we are aware, the volume of water contained in the large lakes of Ireland has not yet been carefully worked out, but, taking Loch Neagh, for instance, which is said to cover an area of 153 square miles (or seven times greater than the area of Loch Ness), and to have a maximum depth of only 48 feet, a rough calculation will show that the bulk of water in Loch Neagh must be less than that in Loch Ness. It seems quite possible, therefore, that Loch Ness may be the largest body of fresh water, not only in Great Britain, but in the United Kingdom.

Correlated with the enormous volume of water in Loch Ness is the high value of the mean depth, which works out at 433 feet for the entire loch. This far exceeds that of Loch Morar, viz. 284 feet, which comes next in this respect. The mean depth of Loch Ness is equal to 57·4 per cent. of the maximum depth—a higher percentage than has been observed in any other large deep loch, the nearest approach to it being in the case of Loch Avich, with a maximum depth of 188 feet and a mean depth of 98 feet, the percentage being 52·4. It is true that in some shallow flat-bottomed basins the percentage of mean depth to maximum depth exceeds that in Loch Ness; as, for instance, Loch Watten in Caithness (70 per cent.), and Loch Bruadale in Lewis (74 per cent.), but the maximum depths are here only 12 feet and 6 feet respectively. Except for Lochs Ness and Avich, in all the deep Scottish lochs, *i.e.* those having depths exceeding 100 feet, the mean depth is less

than one-half of the maximum depth, the percentage varying from 19·4 in Loch Shiel, and 19·5 in Loch Lomond, to 49·4 in Loch Lungard, and 49·6 in Loch Suanival (Lewis).

It has been stated that the surface of Loch Ness stands about 52 feet above mean sea-level, so that by far the greater portion of its floor falls below the level of the sea.

An inspection of the bathymetrical map of Loch Ness shows (1) the comparative simplicity of the basin; (2) the steep shore-slope throughout the greater part of the loch; and (3) the large area of the lake-floor covered by very deep water. The 100-feet, 200-feet, 300-feet, 400-feet, and 500-feet contours are continuous, and only the 600-feet and 700-feet contours are interrupted by a shoaling opposite the entrance of the river Foyers, probably due to the deposition of material brought down by that river. This shoaling is covered by 515 to 524 feet of water, and both to the north-east and south-west the bottom sinks to depths exceeding 700 feet.

The 100-feet basin is about 22½ miles in length, the southern extremity approaching to within 100 yards from the shore at the entrance of the river Tarff, and the northern extremity extending into the narrow part of the loch beyond Torr point, approaching to within a quarter of a mile from Bona ferry.

The 200-feet basin is 21⅔ miles in length, approaching to within 150 yards from the Monastery boat-house slip at Fort Augustus, and quite close to the south-western shore off the entrance of the river Oich, and extending beyond Torr point on the north to within less than a mile from Bona ferry.

The 300-feet basin is 20¾ miles in length, extending from less than 300 yards from the Monastery boat-house slip on the south to just beyond Torr point, or 1½ miles from Bona ferry, on the north.

The 400-feet basin is 20 miles in length, distant over a quarter of a mile from the Monastery boat-house slip on the south, and about three-quarters of a mile from Torr point, or over 2 miles from Bona ferry, on the north.

The 500-feet basin is about 18½ miles in length, distant less than a mile from the Monastery boat-house slip on the south, and about 1½ miles from Torr point on the north. The southern extremity of this basin differs somewhat from the usual truncate form, partaking of a rectangular character.

The two 600-feet basins are separated by an interval of little over half a mile, and are almost exactly equal in length, both of them slightly exceeding 8 miles in length. The northern one is distant about 2 miles from Torr point, and the southern one less than 2 miles from the Monastery boat-house slip at Fort Augustus.

The two 700-feet basins are separated by an interval of nearly 2½ miles, the northern one being nearly twice as long as the southern

one, and including the maximum depth of the loch—754 feet. The northern basin is $6\frac{1}{8}$ miles in length, and distant about $2\frac{3}{4}$ miles from Torr point, while the southern basin is $3\frac{1}{8}$ miles in length, and nearly 6 miles distant from Fort Augustus. The maximum depth recorded in the southern basin was 739 feet near the southern end of the basin, while towards the northern end of the basin a depth of 735 feet was recorded, the intervening soundings being slightly shallower.

These details show how extremely symmetrical Loch Ness is in all its bathymetrical characteristics. All the contour-lines, except the deepest one, approach rather closer to the southern than to the northern end of the loch, but in the case of the 700-feet contour this is reversed.

The shore-slope on both sides of the loch is nearly everywhere steep. Gradients exceeding 1 in 1 are of frequent occurrence, and in certain places the slope approaches the precipitous. Near the southern end of the loch, off the south-western shore at the entrance of the river Oich, a sounding in 204 feet was taken about 100 feet from shore, but the steepest slopes were observed off the north-eastern shore in the vicinity of the Horseshoe craig, where a sounding in 236 feet was taken about 100 feet from shore; another in 175 feet about 50 feet from shore; and, off what is known as the Cormorant rock, a sounding in 206 feet was taken about 50 feet from shore. This last-mentioned sounding gives a gradient exceeding 4 in 1, or an angle of about 15° from the perpendicular.

The steep shore-slope is further seen by the manner in which the contour-lines of depth as a rule hug the shores, leaving a comparatively very large area of the lake-floor along the central line of the loch covered by very deep water. This is strikingly shown by the fact that nearly one-half of the entire basin is covered by more than 500 feet of water, and over one-third by more than 600 feet of water. In the following table are given the approximate areas in acres between the consecutive contour-lines drawn in at equal intervals of 100 feet, and the percentages to the total area of the loch :—

Feet.	Acres.	Per cent.
0 to 100	1892 ...	13·6
100 „ 200	1340 ...	9·6
200 „ 300	1610 ...	11·6
300 „ 400	1121 ...	8·0
400 „ 500	1329 ...	9·5
500 „ 600	1627 ...	11·7
600 „ 700	2461 ...	17·7
Over 700	2556 ...	18·3
	13,936	100·0

This table brings out several interesting peculiarities when compared with the similar tables published for the other large Scottish lochs. The most remarkable point is that the two deepest zones are larger than any of the other shallower zones, the deepest zone of all,

though the interval between the 700-feet contour and the maximum depth is only half the usual interval between the contour-lines, being the largest of all. Such a distribution of the depth-zones has not been observed in any other loch, and is a reversal of the usual rule of the shallowest zone being the largest one, though one or two exceptions to this rule have been recorded, as, for instance, in Loch Treig, where the zone between 200 and 300 feet is larger than either of the two shallower zones, and in Loch Lochy, where the zone between 100 and 200 feet is a little larger than the shore-zone. In the deepest of all Scottish lochs, Loch Morar, the shore-zone is equal to 42 per cent. of the total area, and the second zone between 100 and 200 feet is equal to 13 per cent., while of the deeper zones not one exceeds 9 per cent. of the total area. In Loch Lomond, again, the shore-zone is equal to 68 per cent. of the entire area, and the second zone between 100 and 200 feet is equal to 16½ per cent., while the deeper zones are in each case less than 6 per cent. In Loch Ericht the shore-zone is equal to 34 per cent., the second zone between 100 and 200 feet is equal to 25 per cent., and the third zone between 200 and 300 feet is equal to 19 per cent. of the total area, the deeper zones in each case not exceeding 10 per cent. In Loch Tay there is a regularly decreasing percentage in the zones of depth from the shore into deep water, the numbers for each zone at intervals of 100 feet being respectively 30, 23½, 21, 15½, 9.

DR. STEIN'S EXPEDITION IN CENTRAL ASIA.*

SINCE sending you my last news three months ago from Keriya I have covered a good deal of ground on my journey eastward, close on 1290 miles marching distance. Considerations connected with the limited winter season, during which alone excavations are possible at the more distant of old sites in the desert, obliged me to time my arrival in the Lob Nor region by the beginning of December. The effort to combine with this rate of progress thoroughness in the exploration of what ancient remains could be traced *en route* along the southern edge of the Taklamakan has caused no little strain.

My first objective was the ancient site in the desert north of Niva, where in 1901 I had discovered the remains of a settlement abandoned in the latter half of the third century A.D. Want of time and of adequate labour had then prevented me from clearing some of the ruins more deeply buried by drift sand; subsequent roamings of "treasure-seekers" had led to the discovery of other homesteads hidden away among the high sand-cones on either side of the main groups. Working with as large a party of labourers as I could keep supplied with water from a

* Communication from Dr. M. A. Stein.

distance of some 20 miles, I cleared now close on thirty more dwellings. They yielded ample antiquarian spoil, including many implements and household objects illustrative of everyday life seventeen centuries ago. The numerous relics of industrial art and architectural wood-carving clearly reflect the predominant influence of Græco-Buddhist art as developed on the Indus. Finds of records, written on wooden tablets, in the Kharoshthi script peculiar to the extreme north-west of India, and in an early Indian dialect mixed with a good deal of Sanskrit, have been abundant. Among these records, generally in excellent preservation, all kinds of correspondence, official and private, deeds, accounts, etc., seem to be represented. A "haul" of special importance was secured in the comfortable residence of a local official, who, besides leaving files of papers, *i.e.* tablets, scattered on the floor of his office room, had taken care to hide quite a small archive, undoubtedly documents of value, below one of its walls. From the way in which the place of deposit was contrived and marked, it appears highly probable that the house was abandoned in some emergency. All the deeds, etc., found here still retain their original wooden covers and string fastenings in perfect condition. Among the dozens of intact clay seals which attest these documents, impressions from Græco-Roman intaglios prevail. Their appearance, side by side with Chinese seals, seems to symbolize as it were the part played by Scythia extra Imaon in the early cultural interchange between the classical West and the Far East.

Near several of the ruins the ancient orchards, fenced gardens, canals, etc., could be traced with great clearness, showing how little the economic conditions differed from those of the present oases. On the other hand, surveys effected in the desert beyond, showing the course and extent of the river from which this ancient colony drew its irrigation, strikingly illustrated the great physical change which has taken place here since the settlement was abandoned. An instance of the clearness which prevails for certain periods in the desert atmosphere, so much abused for its dust haze, may find mention. For several days at the close of October the main Kunlun range, some 140 miles away to the south, could be made out so distinctly that it became possible to connect our position at the old site by triangulation with peaks previously fixed above Surghak by Surveyor Rai Ram Singh. On leaving Khotan I had deputed the latter for independent survey work along the foot of the great range. In spite of trying conditions of ground and climate, he attained the main object by extending the net of the Indian trigonometrical system from the headwaters of the Keriya river right through to the mountains between Charchan and Charklik. The northern slopes of the range were also mapped by plane-table on the scale of 4 miles to 1 inch.

The march through the desert between the Niya river and Charchan enabled me, among other tasks, to solve an archæological problem of

wider bearing. Hsuan-tsang, the great Chinese pilgrim, when passing here about 645 A.D., found no inhabited place on the ten days' march, but saw, about midway, ruins of old settlements abandoned to the desert. His reference pointed clearly to the site near the Endere river where, in 1901, I had excavated the ruins of a sand-buried fort. Epigraphical finds had proved it to have been occupied about the beginning of the eighth century, and abandoned during the Tibetan invasion soon after. The question thus arose whether we had here a definite historical instance of an old site abandoned to the desert, having been reoccupied after the lapse of centuries. Discoveries made on my fresh visit have furnished conclusive evidence. The low dunes around the old fort had shifted since my previous visit, and had exposed not far off much eroded remains of ancient dwellings. A careful clearing of the consolidated refuse heaps which had saved them from complete decay, brought to light Kharoshthi records on wood which clearly belong to the close of the third century A.D. or thereabout. Subsequently I found rubbish deposits of the same period embedded under the clay rampart of the later fort. It is significant that the second half of the seventh century, which must have seen Hsuan-tsang's ruined site brought to life again, is just the period when the re-establishment of Chinese power in Eastern Turkestan secured for a time peace and prosperity.

The case of Charchan, through which my journey took me at the close of November, well illustrates the *péripéties* to which these isolated settlements along the southern edge of the Turkestan desert have been peculiarly liable at different periods. A Chinese Buddhist pilgrim found, in 519 A.D., the oasis occupied by only a hundred families. Hsuantsang, more than a century later, saw there the walls of an old town still standing, but there were no inhabitants. Yet when Chinese rule had been re-established soon after his passage, Charchan figures once more as a place of importance. Marco Polo's description of the "Province of Charchan," fully verified on other points, mentions numerous towns and villages. But cultivation had completely disappeared by the end of the eighteenth century, and probably long before it. Settled once more by the Chinese as a small penal station about seventy or eighty years ago, Charchan has now developed into an oasis of steadily increasing size. There is abundance of water to permit of further expansion. Outside the oasis, to the west and south-west, marks of former occupation could be traced over extensive areas of wind-eroded ground in the shape of potsherds and similar hard *débris* of small size.

On the journey from Charchan to Charklik I was able to trace remains of the Mohammedan period in the wilderness of sandy jungle along the Charchan river, and to examine closely the ruins of an earlier settlement abandoned about the twelfth century close to the recently revived small oasis of Vashshahri. Antiquarian evidence collected at Charklik, the

present headquarters of the Lob Nor district, clearly proves that we must look here for the ancient capital of the Lob Nor region, as Hsuan-tsang knew it under the name of *Lou-lan*. Also Marco Polo's "town of Lop" may safely be assumed to have stood there. At Charklik I was kept busy for three days organizing my long-planned expedition to the ancient site which Dr. Hedin had first discovered in 1900 on his journey through the desert north of Lob Nor. The intervening distance was more than 160 miles, but there was no place nearer whence to draw the requisite transport, supplies, and labour. Charklik itself, reclaimed from the desert only some seventy years ago, offers scarcely more than the resources of a fair-sized village, and as its cultivators naturally dreaded a winter campaign in the distant desert, it would have been impossible to secure what I needed but for the energetic assistance of the local Chinese magistrate. By December 6 I was able to start for Lob Nor with a large *posse* of labourers and a month's supplies for the whole camp. As my route passed by Miran, where, not far from a small area of cultivation, ruins of "an old town" were reported to exist, I made a short halt there for the sake of trial excavations. They were rewarded by interesting discoveries more readily than I had expected. From rubbish-filled rooms which I cleared within a ruined fort still rising in parts to imposing height, there emerged in rapid succession close on three hundred Tibetan records on wood and paper, besides a variety of curious household implements, articles of military equipment, etc. There can be little doubt that these refuse layers accumulated during the period of Tibetan occupation which followed the weakening of Chinese power in the eighth century A.D. Whether the remains of a Buddhist shrine and of several stupas in the vicinity of the fort belong to the same period, or, perhaps, are of earlier date, will be investigated when I return to the site for further excavations.

At Abdal, a small fishing hamlet, from where the move into the desert was to be made, we left the ponies and all baggage that could possibly be spared. The question of arrangements about "transport and supply" thence was rather an anxious one. I had been able to collect only twenty-one camels, and had to take with them, over 100 miles of absolute desert, the *impedimenta* of a party numbering over forty people, including supplies for a month, and water sufficient to last us all for a fortnight. Fortunately, severe cold had set in just in time for the latter to be taken in the form of ice. Otherwise the climatic conditions were sufficiently trying, with minimum temperatures falling to as low as 48° Fahr. of frost, and an icy wind blowing from the north-east for varying periods almost every day. The route followed on the seven days' march to the ancient site lay necessarily close to the one taken by Dr. Hedin on his memorable journey of 1900 in the reverse direction. But for the first part the physical aspects of the ground traversed showed a notable change. The great newly formed lagoons in which the

waters of the Tarim had then spread northward, have since almost completely dried up. The water of the rare pools left behind in the salt-encrusted depressions was so salt that, in spite of the great cold, it had not yet frozen.

In the desert beyond finds of worked flints and other implements of the Stone Age, together with fragments of very coarse pottery, occurred frequently over stretches of wind-eroded ground. These proofs of early human occupation cropped up along our track through the whole of the extensive area believed to form part of an ancient lake-bed. The first relics of historical times, in the shape of Chinese coins belonging to the early centuries of our era, were met with fully 10 miles south of the site. The remarkable accuracy with which the position of the latter proved to have been fixed in Dr. Hedin's map, enabled us to find the ruins exactly where we first looked for them, even though the ground traversed, with its maze of deep wind-cut trenches and intervening steep clay banks, was as deceptive to the eye as it was difficult for the camels.

Thus by the evening of December 17 I was able to pitch camp at the foot of the ruined stupa, which stands out in this weirdly desolate landscape as the landmark of the main group of ruins. A blizzard which we had encountered on the previous day proved a blessing in disguise; for the snow it brought, light as the fall was, enabled us to extend our stay at the site to the length needed for systematic excavations, even though the springs at the foot of the Kuruk-tagh, about two marches northwards, from which I had hoped to replenish our store of ice, failed us. Their water was too salt to be drunk even by the camels, and the ice they had just begun to form was unfit for human consumption.

The excavations carried on unremittingly for eleven days at the several groups of ruins have yielded plentiful results. It is true, wind-erosion had worked terrible havoc among the dwellings constructed of timber and plaster walls, exactly like those of the Niva site; but others had retained a sufficient cover of drift sand or consolidated refuse to afford protection to many interesting relics. In a large rubbish heap, fully 100 feet across, we struck a particularly rich mine. The finds of written records, on wood and paper, proved throughout remarkably numerous, considering the limited size of the settlements and the number of extant buildings. The majority of the records are Chinese, and still await examination by my *literatus*, but the number of Kharoshthi documents is also considerable. Their character and the observations made as to their places and conditions of discovery, clearly indicate that the same early Indian language as found in the records of the Niva site, was used locally also in the Lob Nor region for administrative purposes and private business. Considering the great distance which separates Lob Nor from Khotan, this uniform extension of an

Indian language to the extreme east of the Tarim basin has a special historical significance. No less striking is the agreement which the constructive features of houses and shrines, the architectural wood-carvings, objects of industrial art, etc., discovered here present with those of the Niva site. Even without the evidence of dated Chinese documents and of the numerous coin finds, it would suffice to prove that the Lob Nor ruins were abandoned about the same time, *i.e.* the close of the third century A.D.

Clear evidence has been obtained showing that the principal group of ruins represents the remains of a small fortified station garrisoned by Chinese troops. Its purpose was manifestly to control the route leading from Sha-chou, on the extreme west of Kansu, to the oases along, and to the north of, the Tarim. From a variety of indications, it may be concluded that the settlement around this station derived its importance far more from the traffic with China which passed through it than from the resources of local cultivation. This source of affluence may account for the relatively large number of Buddhist religious structures.

By December 29 the exploration of all remains traceable was completed. Sending the main camp with the archæological "proceeds" back to Abdal, I set out myself with a few men through the unexplored desert south-westwards. We reached the Tarim safely after a seven days' tramp, but, owing to the steadily increasing height of the ridges of drift sand we encountered, progress was far more difficult than on the journey from Lob Nor. In its physical aspects this part of the desert showed certain marked differences. The ground, where not covered by dunes, bore here, too, indications of having formed part of an ancient lake-bed. But the rows of dead trees so frequently met on the previous route, marking the banks of old lagoons or river courses, were soon left behind here. Relics of the Stone Age were met with at intervals.

After surveying some localities of archæological interest on the lower Tarim and Charchan rivers, I am now proceeding to resume my excavations at Miran. On their completion, I intend to set out on the month's journey to Sha-chou. Ancient remains are not likely to be met on this desert track until we reach the outposts of old Chinese occupation about Lake Kara Nor. Yet the knowledge that I shall be following the route of Hsuan-tsang and Marco Polo, and what was once a main line of communication between Cathay and the West, is bound to give interest to the journey.

Camp Jigdalik-oghil, January 15, 1907.

P.S.—I have been obliged to postpone the despatch of the men who are to take my mail along with the collections of antiques to Kashgar, and this enables me to add a brief note on my resumed excavations at Miran. Their results have far exceeded my hopes. A complete clearing

of the ruined fort brought the number of Tibetan records found in its rubbish heaps to a total of close on a thousand. There can be no doubt that the stronghold was intended to guard the direct route to Shachou, which also at the present day passes below the fort walls. But of far wider interest and importance are the art remains which emerged from the *débris* mounds of the Buddhist shrines previously mentioned. These must have been in ruins for four or five centuries before the Tibetan occupation. In one of them there came to light colossal stucco relievos showing the closest relation to Græco-Buddhist sculpture of the first centuries of our era. The influence of classical art is reflected with surprising directness in the fine frescoes which cover what remains of the walls of two circular temples enclosing stupas. The main paintings, which illustrate scenes of Buddhist legend or worship, are remarkable for clever adaptation of classical forms to Indian subjects and ideas. But even more curious are the figures represented in the elaborate fresco dados. They are so thoroughly Western in conception and treatment that one would expect them rather on the walls of some Roman villa than in Buddhist sanctuaries on the very confines of China. One cycle of youthful figures in a gracefully designed decorative setting represents the varied joys of life—a strange contrast to the desolation which now reigns in the desert around the ruins, and, in fact, through almost the whole of this region. Kharosthi inscriptions painted by the side of the frescoes, and pieces of silk bearing legends in the same script indicate the third century A.D. as the approximate period when these shrines were deserted. The excavations and other labours were made very trying by intense cold and the frequency of icy winds, which sweep with their full force this bare desert glacis of the mountains.

Camp Miran, February 6, 1907.

MAP OF THE ANGLO-GERMAN BOUNDARY FROM THE VICTORIA NYANZA TO KILIMANJARO.*

THE map is a reduction from the topography, on the scale of 1 : 100,000, made by the English and German sections of the Anglo-German Boundary Commission during 1904 and 1905. The country which lies on the British side of the boundary was surveyed by the British, that on the German side by the German, section of the commission. The framework on which the topography is based consisted of a single series of well-conditioned triangles observed with 6-inch and 5-inch micrometer theodolites, with an average triangular error of ± 6 seconds. One end of this series includes the Cape observatory—Aden telegraphic

* Map, p. 116. To illustrate Major G. E. Smith's paper, *Geo. Jour.*, vol. 29, p. 249 (March, 1907).

longitude point on the British Consulate at Zanzibar, and the chain reaches as far as the topography does to the west.

The heights are all trigonometrical. Vertical angles were taken on each ray at all the main triangulation stations. The initial height was that of Chala hill, which had been fixed by the Anglo-German Boundary Commission of 1892 with reference to the mean sea-level of the Indian ocean at Vanga. The line of heights thus carried up to Victoria Nyanza differed some 8 feet only from that brought up by the Uganda railway levels from Mombasa.

At the scale on which this map is published, 1 : 500,000, the physical detail may be said to be correct, and will require no alteration even if a more accurate survey be made later on.

The country in the area surveyed differs in no way from the usual African upland bush, whose characteristics vary but little with the altitude from 1500 to 5000 feet above the sea. At altitudes greater than 6000 feet the vegetation assumes a more park-like character, such as one is accustomed to see at home. The density of the forest growth depends on the rainfall or condensation, which varies according to the aspect of the slopes. These conditions include all the varieties of country included in the survey. Looking at the map, we see that the country from Lake Jipé on the east rises gradually to the plains on the east and north of Kilimanjaro, culminating at a height of 19,318 feet in the highest point of the snow-covered crater edge of Kibo. From these plains the country rises gradually to Mount Erok, falling again through a very broken country full of countless successions of parallel (north and south) faults to the bottom of the great Rift-valley.

This is the lowest level reached by the survey, 2000 feet at Lake Natron. The western escarpment of the great Rift-valley rises from the shore of this lake to a height of over 7000 feet in a single and almost vertical steep to the summit of Mount Sambu. The boundary-line then rises to about 8300 feet over a series of rugged spurs and deeply cut densely wooded gorges. The park-like country at the summit gives way gradually, as the country falls, to the drier thorn-bush of the Mara river plains. Then from the top of the Isuria escarpment, which, unlike the western side of the Rift-valley, rises as an almost unbroken barrier along its whole length, we find the scattered clumps of bushes and long grass giving way with the drop in height, as the country falls to the shore of Victoria Nyanza, to the thorn bush and yellow burnt-up grass of the lower veld.

REVIEWS.

EUROPE.

Northern Sweden.

'Norrland.' Naturbeskrifning af A. O. Högbom. Almqvist & Wiksells Bogtryckeri: Uppsala and Stockholm. 1906. Pp. 412. *Maps and Illustrations.*

The northern districts of Sweden, known collectively by the name of Norrland, extend along the Gulf of Bothnia from the Dal river south of Gefle, northwards to the Finnish boundary at the Torne river, and inland to the mountain backbone of the peninsula on the Norwegian frontier. With an area of more than 100,000 square miles, they form nearly three-fifths of the Swedish territory, but at present they are sparsely populated, and are chiefly noted for their rich iron-mines in Norrbotten, at Gellivare, Kirunavara, and Luossavara. Information about the physical features, economic resources, etc., of Norrland is to be found only in scattered articles and publications not readily accessible to those who have most need of it, and therefore it was proposed some years ago by Dr. Franz Kempe that a series of handbooks should be compiled, and with his assistance and support this project is now being carried out under the supervision of Prof. Högbom. The present volume, the first of the series, contains a general survey of the geology, climate, fauna and flora of Norrland, drawn from works of the author himself and those of other specialists, lists of which are given at the end of each section. Norrland trends from south-west to north-east, and its geology and configuration correspond to this direction. Archæan rocks, chiefly granite and gneiss, with large areas of porphyry, porphyritic schists, clay slates, and mica-schists, stretch far inland from the Gulf of Bothnia. West of these is a small zone of Silurian rocks, while the mountain axis of the peninsula is composed of rocks partly pre-Cambian (Seve group) and partly of Silurian age (the Köli group), the latter, however, differing so much in appearance and character from the rocks of the Silurian zone already mentioned that they have been marked on the geological map by a special colour. When the country emerged from the sea at the end of the Silurian period, its surface in all probability sloped gradually towards the south-east in the direction of the existing river-valleys. The erosion of these valleys was probably commenced when the surface rose far above the tops of the present mountains. A striking proof of this is the occurrence of transverse valleys where the rivers have cut through rocks offering greater resistance to denudation. In some cases the breaches are incomplete, the stream having been unable to excavate its bed as rapidly as the ground behind it was lowered by denudation. The deposits of loose detritus date from the last stage of the Glacial period or later times, all earlier accumulations having been swept away by the ice-sheet. Glacial detritus is widely distributed, and moorland occupies about 30 per cent. of the total area, while marine deposits indicate a transgression of the sea up to 900 feet in some parts. Lakes are numerous, and occupy about 6 per cent. of the total area. Most of them, including Hornafvan, the largest and deepest of all (725 feet), have been formed by damming, though the deepest parts may in some cases lie in rock basins. A large reserve of motor force is stored up in falls, including the Krångede falls on the Indals river, with about 60,000 horse-power, and the Harsprång on the Luleå, with 46,000. Prof. Högbom also discusses the flora, in the distribution of which the most marked line is the upper limit of conifers running at heights of 1400 to 2600 feet above sea-level, above which the birch region extends to a vertical height of 165 to 650 feet; and he also points out several anomalies of distribution which are still not thoroughly explained. Similar difficulties also occur with regard to the fauna. The peculiarities of the

water-fauna are common to the Baltic basin, the relict fauna of which has been often discussed. It is interesting to learn that a skeleton of a Greenland seal has lately been found near Sundsvall under circumstances which prove this animal to have existed in the Gulf of Bothnia during the Littorina period.

The foregoing brief notes will serve to show how wide a range of subjects is dealt with in Prof. Högbom's work, which is accompanied by geological, hypsometrical, and other maps, and numerous illustrations. For those who wish to study any particular subjects in greater detail the bibliographical lists will be a valuable guide.

AFRICA.

Abyssinian History.

'Rerum Æthiopicarum Scriptores occidentales inediti a sæculo xvi. ad xix. curante C. Beccari S.I.' Vols. **2** and **3**, "P. Petri Paez S.I. Historia Æthiopiæ," Liber i. et ii., and iii. et iv. *Plates.* Vol. **4**, "P. Emmanuelis Barradas S.I. Tractatus Tres historico-geographici." Romae: C. de Luigi. 1905–1906. *Price* 20*s.* 8*d. each vol.*

There is a notice of Father Beccari's introductory volume in this *Journal* for August, 1904. Volumes **2**, **3**, and **4**, which have appeared since, contain the works of Peter Paez and of Barradas; they amply fulfil the hope of important additions to historical geography. Paez's manuscripts have been utilized by later writers, who have extracted his valuable remarks on the expedition of Christovão da Gama, but the modest words in which he records his culminating feat, the discovery of the sources of the Blue Nile, must always retain their interest. With his words and Bruce's before us, we can see the character of the latter's attack. There is no space to expose the whole of Bruce's misstatements. Suffice it to say that Paez makes no mention of a mountain full of water, out of which Bruce makes such dreary fun; that he does not mention a place called Sabala, as Bruce says, but one called Çahalâ, which word differs little from Bruce's Sacala; and that where Paez estimates a certain object as an "espingarda" shot distance, Bruce has no authority for translating it a "cannon shot," or for referring to it later as "a league," or "the largest range of a shell shot from a mortar," because "espingarda" is a matchlock—the weapon of an infantry man. No excuse can avail Bruce, for he says he had consulted two manuscripts, and that he had with him on the spot a copy from one of Paez's accounts. Paez was born in 1564, and was in India in 1588 when first detailed to accompany Antonio Monserrate to Abyssinia. Their attempt to reach that country failed, and they had to spend long years of captivity in Arabia, chiefly in Sana and Mocha, before they again saw Goa in 1596. Their mention of the coffee they drank in Arabia is the earliest notice of it by a European traveller in that country. It was not till 1603, and then alone, that Paez succeeded in reaching Abyssinia; he spent the rest of his life, till his death in 1622, in travelling from one end of it to the other. Omitting his refutation of the errors of Urreta, a writer on Abyssinia long since forgotten, and his dissertations on dogmatic theology, there is a residue of very great value. He was a man of considerable ability, who utilized his Arabian captivity to learn Arabic and Hebrew, and who, judging from his translations of chronicles, acquired Amharic or Geez in Abyssinia. Where his religious training does not interfere, he is a cool and sagacious observer. He is told in Arabia that the Arabs had seen his companion Monserrate floating in the air on the level with the treetops while he prayed. This is retailed; but when he is told in Abyssinia that vultures throw stones at their pursuers, he watches the birds as they are driven out of the royal camp by the pages, and reaches the rational explanation that the birds do not throw stones, but that if they step on a loose one they may kick it back as they run. His account of the unsuccessful attempt of

Antonio Fernandez to penetrate to the African coast at Melinde is interesting. On page 271 of vol. 2, the word *Xanjada* has puzzled the editor; this form exactly reproduces the sound of the Southern India word *Shangadam*, "a raft." Barradas carries much less weighty metal than Paez. He was born in 1572, and though commencing with the Jesuits in 1587, he was not fully admitted until 1612, and then in India. In the contemporary confidential note of his corps he is described as "judicium mediocre" and "constitutio cholericus, adustus." He reached Abyssinia in 1624, just after Paez's death, and left with the other Jesuits on their expulsion in 1634. His knowledge of the country is confined to Tigré, but that he knew well, and his description of it and of the manners and customs of its people is very interesting and minute, and shows considerable power of observation. Three treatises of his are published here: the first is of no value—theological—the second is his account of Tigré, and the third a very detailed description of Aden. He apparently had never seen the printed accounts of Da Gama's expedition, but his report of the oral traditional account of the events occurring in Tigré is exceedingly valuable, and shows that recent research is justified in the conclusions drawn as to the line of Da Gama's advance. Barradas died in India in 1646.

R. S. W.

German Nyasa and Rovuma Lands.

Dr. F. Fülleborn, 'Das Deutsche Njassa- und Ruwuma-Gebiet, Land und Leute, nebst Bemerkungen über die Schire-Lander. Mit Benutzung von Ergebnissen der Njassa- und Kingagebirgs-Expedition der Hermann und Elise geb. Heckmann Wentzel-Stiftung verfasst.' Deutsch-Ost-Afrika, vol. ix. Berlin, 1906. Pp. 636, figs. 210. *With Atlas*, 119 *Plates, and* 2 *Maps*.

The series of monographs entitled 'Deutsch-Ost-Afrika' is well known as including some of the most important contributions to the scientific geography of tropical Africa. The ninth volume, by Dr. Friedrich Fülleborn, maintains the high standard of this work. It describes the southern part of German East Africa, including the districts between the coast and the northern part of Lake Nyasa. Most of the area is in the basin of the Rovuma river, which divides the German territory from Mozambique.

The author had excellent opportunities for quiet research. He lived in the country from 1897 to 1900 as doctor in the military service. He accompanied the Wentzel Zoological Expedition to Nyasa and the Kinga mountains, and he was engaged in some military excursions against insurgent natives, and they give unusual opportunities for making extensive ethnographic collections. As a medical man the author has naturally turned his attention mainly to anthropology. He devotes two short chapters to a concise narrative of his journeys, and he briefly describes the chief feature in the geography, geology, and biology of the region.

The chief feature of this book is its monographic account of the natives. The information given is detailed; and it is arranged with such excellent method, and provided with so good an index, that the material is all easily available for reference. The index consists of 64 pages, with three columns on a page, and with eight extra pages for index to authorities.

The natives are, of course, all Bantu, and the author divides them into eight tribes, of which the Wamuera, Wakonde (and their branch the Wamatambwe), and the Mawia are the aborigines; the rest—the Wayao (Livingstone's Ajawa), the Wamakua, Wangindo, the Wamanganja and their allies, and the Wandonde—have immigrated into the country in recent times. Seventy or eighty years ago the Wamuera were a much greater people than they are to-day. The Wamatambwe were a very numerous race in the days of Livingstone, but they have been driven by invasions of the Wayao and Makua from their old home in the lowlands beside

the Rovuma, and forced to migrate further up the valley, where the remnants of the tribe are scattered among other people. The Wayao are the most important of the recent invaders; their chief area is now in Portuguese territory south of the Rovuma, but the author thinks they originally came from the country behind Kilwa, and their present tendency is to return northward. One chapter is devoted to sport and fishing; but it describes native methods and not the author's experiences. There are many interesting additions to knowledge of the initiation ceremonies, by which boys and girls are admitted to the ranks of the adults.

There is much in the country that reminds the reader of the corresponding highlands to the south of the Zambezi in Mashonaland. The physical conditions of the two countries are in many respects similar: the people are allied in race; they live in huts of the same design, and often protected between granite tors as in the kopjes of Rhodesia; the natives use similar weapons, and show the same skill in smelting iron—of which industry the author gives an excellent account (pp. 166–174). The people in both districts are fond of depicting animals; they make wall-paintings of giraffes, zebras, and antelopes, which are cruder, but of the same character as the Bushmen paintings of Cape Colony; and the members of some tribes, such as the Wadonde and Wamuera, tattoo figures of antelopes, trees, and birds upon their bodies. The author gives detailed and most interesting accounts of native architecture; but we look in vain for any traces of stone buildings of the Zimbabwe type. The explanation of their absence may be the lack of important mineral wealth in the Rovuma basin; it yields garnets (to the value of 63,000 marks in the year 1901–1902), as well as beryls and other stones; it has some ores of copper and widely distributed iron; and in the schists of the Livingstone mountains there are some quartz veins containing a little gold, but the gold ores are too poor to work. Hence there is no trace of former extensive mining operations, and there appear to be no stone buildings such as those on the goldfields of Rhodesia.

The country in the main consists of a plateau of gneiss disrupted by the earth-movements to which East Africa owes some of its most striking geographical features. The author gives a sketch-map of the rift-valley system at the northern end of Lake Nyasa, which he has drawn up in consultation with Dr. Kohlschutter, incorporating in it the latest information available. The Nyasa rift-valley breaks up at its northern end into two parts, surrounding the Unyika Horst, which is cut off from the Nyasa-Tanganyika plateau by the Inyamanga rift-valley; the two branches reunite to form the Rukwa rift-valley, which joins that of Tanganyika at Karema, the Mkamba river flowing through the north-western part of it. The Ruaha rift-valley branches to the north-east from the main line, and separates the Ukimba plateau from the Elton plateau, which is the northern end of the Livingstone mountains. The southern end of these mountains is marked by a tectonic fracture, which the author calls the "Ruhuhu-Bruch."

The frontispiece is a fine view of a typical crater lake, that of the extinct volcano Ngozi; but volcanic activity in this district is dead. In the Songwe valley there is a group of hot springs, which have deposited an extensive mass of sinter. These "Grafin-Bose" hot springs stand, however, on a great fault, and therefore appear to be due to tectonic and not volcanic causes.

The volume is accompanied by an atlas of unusual value. It includes two maps: one a copy of part of the official map of the state on the scale of 1 : 1,000,000, on which is marked the author's routes. A second map on the scale of 1 : 510,000 illustrates the topography of Konde Land. The maps show by coloured numbers the sites and direction of the photographs in the atlas, which consists of 119 plates (12″ × 17″) containing 845 figures. They give a pictorial account of the country,

and a most graphic representation of the life of the people. They show the banana-leaf bivouacs, the bamboo bridges, the fortified villages, the gigantic fish-traps, and the methods of iron smelting. They illustrate some of the diseases and the tribal marks, including scar-tattooing and the manipulation of the hair and teeth among representative tribes. One set of ten photographs shows a man making the manual signs for the numerals 1 to 10. Another illustrates a method of inducing a cow to yield milk, which is well known from its use among the Masai, but is probably not adopted in British dairy farms. J. W. G.

GENERAL.

The First Circumnavigation of the Globe.

'Magellan's Voyage around the World.' By Antonio Pigafetta. The original text of the Ambrosian MS., with English translation, notes, bibliography, and index. By James Alexander Robertson. 3 vols., large 8vo. *With Portrait, and numerous facsimiles of the original Maps and Plates.* Pp. 273, 313, and (index) 88. Cleveland, Ohio: The Arthur H. Clark Co. 1906.

Our knowledge of the circumstances of the first circumnavigation of the globe is of singularly unequal character. In some respects it is astonishingly full. We have, for example, the roll of each ship's company—the names of the men, the towns or countries whence they came, and the rank or office that each held. The documents in the Seville archives give a complete list of every article carried in the fleet, even to the number of bells and coloured handkerchiefs intended for barter. But no regular ship's log exists to tell us of the events of the voyage, and the nearest approach to it that we get is the scanty derrotero of Francisco Albo. The narrative of the Italian, Antonio Pigafetta, remains as yet—and is likely to remain—our chief source of information concerning Magellan's wonderful voyage, and it is rather curious that until now we have been without any adequate and trustworthy English version of it. Lord Stanley's translation, published for the Hakluyt Society in 1874, was unfortunate in being a synthesis, partly founded on one of the French MSS. in the Bibliothèque Nationale, and partly on Amoretti's version, which was itself an inaccurate reproduction of the Italian (and oldest) text existing in the Biblioteca Ambrosiana in Milan. This has been the sole available source to the English reader, and accordingly the volumes which Mr. J. A. Robertson here gives us are particularly welcome. They are three in number. Vols. 1 and 2 contain the Italian text and its translation on opposite pages, very full notes (relegated to the end of each volume), and a lengthy bibliography, while vol. 3 is entirely devoted to the index.

Mr. Robertson, though making free use, with all due acknowledgment, of Andrea da Mosto's excellent edition, has himself made the transcript of the Italian from the original, and has collated the text with the French MSS. in the Bibliothèque Nationale in Paris, incorporating all the variants in the notes. These are further enlarged by the readings and comments of previous writers upon Magellan and his expedition, and by Mr. Robertson's own criticisms. The volumes were originally intended only to be issued as a portion of the colossal series on the Philippines now appearing under the editorship of Mr. Robertson and Miss Blair, but it has been wisely decided to publish the work as a small separate edition in order to render it more accessible to the ordinary reader.

In printing the Italian text, the author tells us, "great care has been taken to represent correctly the many peculiar characters and abbreviations occurring in the old Italian, and for this purpose many special characters have been designed and type specially cast." We are not sure that the step was altogether an advisable one. The conjunction of modern roman with these characters, and more especially with

a series of italic letter *s* which stands for the long *s* in the manuscript, gives a mixed effect which is far from pleasing. Nor, though one may have every respect for a desire for accuracy which has led the author to claim that "the peculiarities of the manuscript have been carefully preserved, even to the spacing," do we think it necessary that this should be carried to the length of dividing words, so that "bombarde" becomes "bom barde," "terribili" "teri bili," "beverono" "beue rono," and so forth. Passing to the translation, we find a certain inequality in the standard adopted. While modern English is used, and considerable effort is apparently made to give as close a rendering of the text as possible, so that we even have "Spagnia" and "Portagalo" where Spain and Portugal might well have served, there are frequent occasions when the English is either too slavish or too free. Thus "the Ocean Sea" and "the holy bodies" can hardly be considered satisfactory equivalents of "Mare Occeano" and "Corpisanti;" and, on the other hand—to pass over various instances of colloquial English—it is a little startling to be confronted with some full-blown Americanisms. In the description of the flying-fish pursued by the albacores, the latter are stated to "run along back of them under the water," and a little further a town is spoken of as "located" at the end of Java Major. Many things, indeed, are "located." But perhaps the most salient instance is the translation of "et non se afaticarebeno se non dui in comandare ali marangoni como douescero fare," as "they would not suffer any fatigues beyond two of them to boss the carpenters in their work." It would be invidious, however, to dwell on these minor drawbacks, in presence of the fact that Mr. Robertson's book gives the reader for the first time the true text of Pigafetta, with a sufficiently good working translation, edited and annotated in the fullest manner, and with the Italian text throughout collated with that of the earlier of the two French manuscripts in the Bibliothèque Nationale and the Eden version as published by Arber. Not least in value, too, is the excellent critical bibliography of Pigafetta MSS. and the printed books relating to the voyage. With regard to the much-debated question as to the language in which Pigafetta gave his story to the world, Mr. Robertson holds that the evidence conclusively proves that he wrote or dictated his relation in Italian; that the Ambrosian MS. is a contemporaneous copy of the one presented to the Grand Master of Rhodes; and that the two Paris MSS., and in all probability the Nancy MS., are translations (the first two very imperfect) of the Italian by a Frenchman only indifferently acquainted with the language.

Pigafetta's original charts, which are numerous, are carefully reproduced, and add to the interest of the work. They should afford material aid in the identification of the places mentioned by him in his narrative, with regard to which much still remains to be done. F. H. H. G.

SHORT NOTICES.

Europe.—'Through Portugal.' By Martin Hume. (London: Grant Richards. 1907. Pp. xiv. and 317. *Illustrations.*) Graphic impressions of Oporto, Bussaco, Cintra, Lisbon, and other places of interest in Portugal make this an attractive volume, the value of which, to travellers, is enhanced by a chapter dealing with ways and means of journeying. Whether describing scenery or architecture the writer is equally clear, and the monotone illustrations are excellent; those in colour are much less successful.

'A Book of the Pyrenees,' by S. Baring-Gould (London: Methuen. 1907. Pp. 309. *Map and Illustrations*), a work as eminently readable as might be expected from its author, deals mainly with the history of the region of the Pyrenees, each chapter treating of some important centre or some well-defined district. A descriptive character, however, runs through the book, and word-

pictures here and there, with a few good photographs, do justice to the natural beauties of the region.

Asia.—'Life and Labour of the People of India.' By Abdullah Yusuf-Ali. (London: Murray. 1907. Pp. xii. and 360. *Illustrations.*) The title of this work precisely indicates its scope; those of the two first chapters, "Town Life" and "Village Life," show that it contains matter of a certain geographical significance. Though a subject so widely ramifying must needs be treated, in these limits, either generally or by means of isolated examples, the result is thoroughly instructive, especially as coming from a writer who is of the people.

'Indian Pictures and Problems.' By Ian Malcolm. (London: Grant Richards. 1907. Pp. xiv. and 294. *Illustrations.*) This book is divided into two parts, entitled respectively "India" and "Burma," and its chapters cover a wide range of subjects—from notes on public school life to a description of the Kolar goldfields, from native religion in Burma to frontier politics and administration. The result to be gained by the reader is therefore rather a series of detached impressions than a connected picture, and the book becomes rather of momentary interest than of permanent value for reference.

'The Seven Cities of Delhi,' by G. R. Hearn (London: Thacker. 1906. Pp. xiv. and 319. *Plans and Illustrations*), is a careful study in the nature of an elaborated guide-book; that is to say, one section is worked out in the form of an itinerary, and the topography and history are framed so as to be of use to visitors to one of the most interesting cities in the world. The arrangement is thoroughly systematic; there is a bibliography, and the author's plans and photographs are excellent.

Africa.—'The Sudan.' By H. Karl W. Kumm (London: Marshall. 1907. Pp. xiv. and 224. *Maps and Illustrations.*) This book deals with the Sudan mainly from the point of view of missionary work, whether treating the country descriptively or historically. One chapter, however, classifies and tabulates vegetable products; another does the same for meteorological observations; while a third deals briefly with waterways, and includes a synopsis of the conditions of the Benue month by month.

'A Picnic Party in Wildest Africa,' by C. W. L. Bulpett (London: Arnold. 1907. Pp. xiv. and 246. *Maps and Illustrations*), deals with a trip in the district of the head-streams of the Sobat. Mingled with the narrative of travel and sport, it contains much miscellaneous description of things seen; the notices of intercourse with the natives, and the topographical details, especially, are of no little interest, and the whole work, while without scientific pretensions, is thoroughly readable.

'Sketches in Mafeking and East Africa.' By Major-General R. S. S. Baden-Powell. (London: Smith, Elder. 1907. Pp. 183. *Maps.*) The text of this book is brief and fragmentary, but not altogether uninstructive; the sketches are the principal feature, and, whether humorous or otherwise, are generally entertaining. Some of the colour reproductions (*e.g.* that of Victoria falls) are beautiful; others are not.

'Uganda by Pen and Camera,' by C. W. Hattersley (London: Religious Tract Society. 1906. Pp. xviii. and 138. *Illustrations*), gives short directions for the journey to and travelling in Uganda, and a narrative of missionary work and its results there.

'Le Periple d'Afrique. Du Cap au Zambèse et à l'Océan Indien.' By Henri Cordier. (Paris: Librairie Orientale et Américaine, [*n.d.*]. *Illustrations.*) Prof. Cordier represented the Société de Géographie on the occasion of the British Association's visit to South Africa in 1905, and this is his narrative. As a French view of the proceedings, and of the country and towns visited, it is of much interest; it is full of excellent, though brief, geographical, ethnographical, and economic

notes; and the journey and arrangements are described from day to day appreciatively, and not without humour.

America.—'Camp-fires in the Canadian Rockies,' by W. T. Hornaday (London: T. Werner Laurie. 1906. Pp. xvii. and 353. *Maps and Illustrations*), is an entertaining narrative of sport, and both the text and the photographers assist to give the reader a mental picture of the country. There are some few scientific notes, and the map of the distribution of the white mountain goat is original.

'The Ohio River.' By A. B. Hulbert. (New York and London: Putnam's Sons. 1906. Pp. xiv. and 378. *Maps and Illustrations.*) This is mainly a history of events connected with the Ohio and the places on its banks, conceived in a somewhat florid style, but thoroughly interesting. The river, a natural highway, lends itself to such treatment as no other physical feature can, and, in issuing this volume and others similar, the publishers help to show how one department of geography can be made an attractive study.

'Paraguay, das Land der Guaranís,' by Wilhelm Valentin (Berlin: Hermann Paetel. 1907. Pp. viii. and 323. *Illustrations*), is, within its limits, a comprehensive study, of a type more frequently produced in Germany than in England. It deals with the geographical and economical and, briefly, with the historical aspects of Paraguay, and should form a useful work of reference on that country.

Pacific.—'From Fiji to the Cannibal Islands.' By Beatrice Grimshaw. (London: Nash. 1907. Pp. xii. and 356. *Illustrations.*) The Cannibal islands is hardly an illuminating term, and perhaps, for the sake of the interest of the moment, it is a pity that the title of this book does not specify the New Hebrides. Out of a mass of what can only be described as the usual sort of personal narrative, it is possible to pick plenty of interesting descriptive information about these and other islands much less familiar than Fiji. The illustrations, as a whole, cannot be commended.

General.—'Lectures on British Colonization and Empire.' First Series. By F. A. Kirkpatrick. (London: John Murray. Published under the auspices of the League of the Empire. 1906.) This work is the first outcome of a scheme of the League to provide lecturers with a series of addresses on the British Empire. A list of lantern-slides (maps and pictures) is provided to accompany each lecture; these can be obtained from the League. The lectures are excellently framed; of the maps, the book, of course, gives no means of judging, but the subjects are well chosen. The selection of pictures (among which portraiture, episode, and scenery all have place) must have been so difficult as to disarm criticism; and the whole compels praise.

'The Rare Adventures and Painefull Peregrinations' of William Lithgow. (Glasgow: Maclehose. 1906. Pp. xiii. and 449. *Original Illustrations.*) This is a reprint, with very slight alterations (correction of printers' errors, etc.), of Lithgow's 'Editio princeps' of 1632. It has a biographical note and a new index, but is otherwise without annotation. It is excellently produced.

THE MONTHLY RECORD.

THE SOCIETY.

Honours to Members of the Council.—At a special congregation held at Cambridge on June 12, and presided over by the Duke of Devonshire, Chancellor of the University, honorary degrees were conferred, among

others, on three of the present members of the Society's Council, two of them being Vice-Presidents. That of LL.D. was given to Lord Curzon, and that of D.Sc. to Sir Clements Markham and Sir Thomas Holdich. The following is the text of the speeches made by the Public Orator in introducing the recipients:—

Assurgit proximus Uniuersitatis Oxoniensis, sororis nostræ uenerabilis, Cancellarius, qui primum inter Etonenses educatus, deinde præmiis in historia Academicis ornatus, postea non modo Indiæ sed etiam rerum exterarum in prouincia administranda domi spectatus, Asiæ trans partem magnam ab imperio Persico usque ad impe ii Sinensis fines ultimos itinera magna confecit, confecta litterarum monumentis stilo lucido conditis commendauit. Per annos duodecim inter Britanniæ senatores electus, deinceps per septennium præclarum Regis nostri uicarius illustris Indiæ toti gubernandæ cum laude plurima præfuit. Qui Indiæ administrationem suam orationibus plurimis et feliciter illustrauit et fortiter uindicauit, nullo alio quam oratoris maximi Romani præconio dignus est. "Quid autem" (ut oratoris illius uerbis utar) "reperiri tam eximium aut tam expetendum potest, quam istam uirtutem, moderationem animi, temperantiam non latere in tenebris neque esse abditam, sed in luce Asiæ, in oculis clarissimæ prouinciæ atque in auribus omnium gentium ac nationum esse positam?" "Simul etiam illud" India "cogitet, nullam ab se neque belli externi neque domesticarum discordiarum calamitatem afuturam fuisse, si hoc imperio non teneretur."

Duco ad uos uirum admodum honorabilem, BARONEM CURZON.

Sequitur deinceps Regiæ Societatis Geographicæ per annos quinquaginta quidem minister indefessus, per duodecim præses præclarus, cuius sub ductu Societas illa diu floruit, et non modo Britannorum in doctrinæ sedibus honoris locum est adeptus, sed etiam terras remotissimas, et præsertim regionem polo Australi propinquam, explorauit. Idem quot iuuenes rei naualis peritos trans maria longinqua scientiarum finibus proferendis excitauit! Quam feliciter ipse ex intimis Peruuiæ penetralibus arborem contra febrium impetus ui salutari præditam, etiam in Indiam, populi totius cum magno commodo, transtulit! Quot regiones peragrauit, peragratas litterarum lumine illustrauit! Ergo, et sibi ipsi, et collegis suis orbem terrarum totum explorantibus, nemo melius poëtarum Latinorum uerba illa potest arrogare:—

"Quæ regio in terris nostri non plena laboris!"
"Vixímus insignes inter utrumque"—polum.

Duco ad uos Regiæ Societatis Scientiarum socium, Regiæ Societatis Geographicæ diu decus et præsidium, equitem præclarum, CLEMENTS ROBERTUM MARKHAM.

Societatis Geographicæ præsidi emerito nemo potest opportunius succedere quam præsidis ipsius uicarius, miles fortissimus, Indiæ totius explorator audax, qui præsertim in tellure Russorum imperio contermina, montium arduorum inter ambages, gentium barbararum inter arma, animo intrepido regionis difficillimæ, regionis prope inextricabilis, fines designauit. Idem in America Australi inter respublicas duas confines controuersiam magnam de limite communi exortam, populi utriusque non sine magno commodo, terminauit. Is autem qui scientiarum doctor hodie nominabitur, itinerum suorum libris stilo facili et facundo conscriptis, non immerito etiam laudem litterarum est adeptus.

Duco ad uos equitem fortissimum, THOMAM HUNGERFORD HOLDICH.

The International Council for the Investigation of the Sea.—This Council met in London for the first time by invitation of the British Government during the week beginning June 10. On the evening of

that date they were entertained to dinner by the Royal Geographical Society and the Geographical Club, when about thirty members of the Council were present. After dinner a meeting of the Society was held, when Dr. Otto Pettersson, Acting President of the Council, gave a lecture on Oceanic Circulation; after that several representative members of the Council gave some account of the varied work which it has been carrying on during the past five years. During the rest of the week the Council held its official meetings, and were entertained by the Minister of Agriculture, the Secretary for Scotland, the Lord Mayor, and the Fishmongers' Company; they were also received at Buckingham Palace by the King, and many of them were present at the Annual Conversazione of the Society at the Natural History Museum, at South Kensington. On the Saturday, Dr. H. R. Mill, who is himself a member of the Council, entertained them at a garden party at his house at Mill Hill.

EUROPE.

The Scottish Peat Mosses.—Since publishing the results of his examination, in 1904, of the peat mosses of the southern Scottish uplands (*Journal*, vol. 27, p. 84), Mr. F. J. Lewis has extended his valuable researches to more northern portions of the same country. As in the former case, he has recorded the data collected, and the conclusions to be drawn from them respecting the climatic changes to which Scotland and neighbouring regions have been subject since the close of the glacial epoch in the *Transactions of the Royal Society of Edinburgh* (vol. 45, part ii., No. 13, 1906). The mosses examined in 1905 fall into two different groups: that of the western districts, represented by Skye and the outer Hebrides (north Uist); and the north and north-east Highlands, in Caithness, Easter Ross, and Inverness. As in 1904, a large number of sections, sometimes extending to a depth of 12 feet and upwards, were taken by the writer, and where these were impossible, borings were substituted. In the western districts the sequence of plant remains was shorter than elsewhere, none typical of arctic or sub-arctic conditions being met with at the base, where *Betula alba* and *Corylus avellana* were abundant immediately above the glacial deposits, showing that the peat began to form under temperate conditions, at least in the spots examined. This basal forest-bed, which is overlain by a large thickness of marsh and bog peat, is perhaps to be correlated with the lower buried forest previously described from the southern uplands, a great similarity being observable between the deposits in these and in the Hebrides. In this case the absence of intercalated arctic plants is possibly to be attributed to the low level at which the beds occur. The upper forest bed of the south will thus be missing entirely in the Hebrides, which might be expected to form a refuge for moisture-loving plants when dry conditions prevailed in the south and east of Britain. The deposits examined in the north and north-east show a much longer succession of beds, which display a marked correspondence throughout the areas examined. The lowest point everywhere to the prevalence of arctic conditions (marked by the presence of arctic willows and associated forms), which gave place gradually to a less rigorous climate, in which an alternation of humid with drier conditions may be traced. At one level a shrubby growth of birch is seen to have found a footing, but it is hardly to be correlated with the lower forest zone of the southern uplands. Its occurrence, over large areas, so soon after the cessation of arctic conditions, may be due to the fact that these had

lagged behind in the wet peat-covered areas longer than in drier neighbouring districts. Higher up, two separate zones of *Pinus Sylvestris* regularly appear, as against one only in the south of Scotland. Mr. Lewis inclines to the opinion that we have here an indication of climatic change, rather than of the action of local conditions, such as have been called into play by Dr. Gunnar Andersson to account for an alternation of forest formations and sphagnum beds in some of the Swedish mosses. The absence of the second zone of *Pinus* in the south may imply that the tree had already died out here, for it is well known that no natural pine forests occur in southern Britain at the present day. In the concluding part of the paper an attempt is made to correlate the various beds with the later glacial and interglacial periods. Mr. Lewis's researches, which it is to be hoped he will continue to prosecute in the future, are calculated to throw much light on the distribution of the British flora, which, as he points out, may owe more to the historical than the ecological factor. They may also help to explain the origin of the Greenland flora, with which some of the earlier remains in Scotland show distinct resemblances.

Tree-lines in the Eastern Alps.—Prof. Newole, of Vienna, has instituted investigations into the altitudinal limits of the various species of trees, and has reached the following main conclusions respecting their dependency on character of the soil, configuration of the land, and exposure, in the north-eastern part of the Eastern Alps. He gave special attention to the beech and pine, and the contrast exhibited between them. The pine mounts higher than the beech, the former rising to the average height of 5940 feet, the latter only to 4630 feet. Within its lower altitudinal region, however, the beech attains to higher situations in the Calcareous Alps than in the zone of primitive rocks. The pine, on the contrary, rises higher on the primitive rocks than in the Calcareous Alps. In the latter, the beech on southern exposures attains the average altitude of 4630 feet, but on northern and western exposures its altitudinal limit falls 300 feet lower. On the primitive rock of the Lower Tauern the beech sinks 230 feet lower still, climbing here to a height of only 4100 feet. The beech loves drought; it prefers sunny slopes, avoiding moist and shady ravines. In valleys in primitive rock it occurs only in lower sunny situations, and is sometimes altogether wanting even here, as also in valleys north of Judenburg, in Upper Styria. On limestone mountains, on the other hand, it mounts high, particularly on southern exposures, whereas here again it is vain to search for it in lower situations. Pine and fir there predominate. In the Calcareous Alps east of the Enns, the upper limit of the pine as a tall-stemmed tree lies at an average height of 4990 feet, as a dwarf at 5610 feet. On the primitive rock from the Wechsel to the lower Tauern, the pine as a tall-stemmed tree rises to the average height of 5630 feet; in the form of dwarf and scrub to 5940 feet. On gneiss the tall-stemmed pine rises, therefore, 650 feet higher than in the Calcareous Alps. The pine is indeed the dominant tree of the Alps. This, however, comes most strikingly to view on the relatively moister soil of the primitive rock. Yet it too affects the sunny slopes, even on limestone mountains. On such slopes it ascends the "Wiener Schneeberg" 590 feet higher than in the valleys and glens. The snow masses falling plentifully in the mountains, especially in spring, take a long time to melt in these shady ravines, and, besides the burden they impose, bring with them an overcharge of moisture, both circumstances injuriously affecting the after-growth. The influence of mountain shade is thus constantly in evidence. Regions of particularly great elevation are the domain of the birch and the Cembra pine. Newole found the birch on the Hochgolling (in the lower Tauern, south of the Dachstein, 9390 feet high) between 5970 and 6350 feet. Kerner von Marilaun, on the other hand, found the Cembra pine in the Tyrolese gneiss Alps in a zone between 5170 and over 6500 feet.

ASIA.

Dr. Tafel's Expedition to Tibet.—In spite of repeated ill luck, this traveller continues to show the most praiseworthy determination in his endeavours to explore some of the least-known parts of North-Eastern Tibet. It will be remembered that soon after his first entry into the Kuku-nor region (*Journal*, vol. 28, p. 398), his caravan was attacked by robbers, losing the greater part of its equipment, so that it became necessary to beat a retreat for the purpose of renewing the supplies. After reorganizing his party, the traveller once more set out, and all appeared to be going well, the caravan having advanced as far as one of the headwaters of the Yang-tse (the Machu of Wellby), when it was once more attacked by robbers and almost all the transport animals—so indispensable for travel across the inhospitable regions of Northern Tibet—were carried off. Letters printed in the fifth number of *Petermanns Mitteilungen* for the present year, the first written soon after this disastrous occurrence took place, picture the parlous plight of the party, whose only hope was to make its way back to Tsaidam with sadly reduced supplies (the greater part having been of necessity destroyed or abandoned) across a practically unknown region, the existing maps of which proved untrustworthy guides. The caravan was on the south side of the Marco Polo range, which had to be crossed in order to reach an inhabited region, but which long presented an impenetrable barrier, with its glaciers and deep snow. The party were in sore straits when they at last reached an encampment of Mongols. Dr. Tafel returned to Sining-fu, whence he wrote on January 15, 1907, announcing the completion of his preparations for a renewed attempt. Before the disaster he had travelled for five months across the north-eastern part of Tibet, subject, in some degree, to the Kuku-nor authorities. From Tsaidam he had crossed the Burhan Buda range and made his way to the ultimate head-streams of the Hwang-ho, which he explored thoroughly. Thence he proceeded to the upper Yangtse, where Tibetans were encountered, who showed themselves distrustful. The river seems to have been crossed, though no details are given of the further route. The country was exceedingly monotonous, and the geology (Dr. Tafel's special subject) uninteresting, the whole consisting of strongly tilted sandstones with a regular strike in the direction of N. 65° W. The attack on the caravan was quite unprovoked, as, with the exception of the party seen on the Yangtse (and this on the opposite bank), no inhabitants had been met with throughout. The authority of the Kuku-nor mandarin is but feebly exercised, and as this functionary had himself proved far from friendly, there was little chance of redress.

AFRICA.

The Livingstone Memorial.—We have received, through the courtesy of the British South Africa Company, the copy of a plan, showing the extent and position of a rectangular plot reserved for the Livingstone memorial, near Old Chitambo's village, south-east of the swamps of Bangweulu. Each side measures 210 feet, giving an area of just over an acre, and the four corners have been marked by beacons. The position is shown as about 3 miles south of the Lulimala river, in 12° 18½′ S. lat., 30° 21′ E. long.

British East Africa.—The Annual Colonial Report for 1905–6 (No. 519) on the East Africa Protectorate estimates the population, at variance from the estimate of the previous year's report, at nearer four than two millions. Parts of the Kenya province have been found to be very densely inhabited. The white population (March 31, 1906) numbered 1813, 264 being Government officials. Among the European population were 38 births and 26 deaths. Normal conditions of health

prevailed in the protectorate. The immigrants included 1861 Europeans and 6454 Asiatics and Africans; the emigrants 1427 of the former, and 6724 of the latter. Work is plentiful, food cheap, and taxes light for the natives. During 1905 land grants amounting to 549,828 acres were made, as against 197,256 acres in 1904. In 1905-6 the total area surveyed amounted to 745,530 acres, against 618,542 acres in 1904-5. The survey of Lake Victoria is practically completed, and useful charts are in preparation. Fifty-three miles of telegraph line have been added in 1905-6, making a total mileage of 2167 miles. An ordinance prohibits possessing and trading in cow ivory and the tusks of immature bull elephants. The highest recorded temperature, 95°, was registered at Makindu on April 3; the lowest, 40°, at Naivasha on June 22. Of all places in the protectorate Nandi had the maximum rainfall in 1905, 99·08 inches, made up by 150 days' rain, 16·7 inches falling in March. At Shimoni 27·12 inches fell in March. In 1905 only 15·81 inches fell at Kismayu, where no rain fell in January, September, and December, there being only 28 days of rain throughout the year. The maximum rainfall on one day, 4·72 inches, occurred at Mombasa on May 9. The yearly average of rainfall for ten years (1896–1905) at Kismayu was 14·78 inches, the maximum in that period, 20·52 inches, being reached in 1902, and the minimum, 6·68 inches, in 1903. The report includes special reports on experimental farms, return of land, industrial, and mining concessions, etc. Altogether, it is one which may be read with solid satisfaction.

The Congo Railways.—An article, with map, in the *Mouvement Géographique* (1907, No. 12) considers the position of the Congo State in respect of railways. The line from Matadi to Stanley Pool was opened in 1898, and in September, 1906, the line from Stanleyville to Ponthierville, carrying with it the utilization of the stretch from Ponthierville to Lumbulumbu. The laying of a railway from Lumbulumbu to Hell Gate, over 180 miles, has been begun, and is expected to be completed by the end of 1910. Before that time the 400-mile section, Hell Gate to Kalengwe, will be taken in hand. Thence to the mines of Katanga there are 150 to 200 miles of line to lay, a work which should take three years—*i.e.* to the end of 1913. But by that date the English railways from Rhodesia and Lobito bay will already connect the Katanga region with the sea. In a year or a year and a half the Rhodesian line will reach Kansansbi, and by the end of 1909 might arrive at the mines of Kambove and Ruwe, enabling Upper Katanga to export its metals by Beira. From Lobito bay, again, the Benguela rail is being laid over the first 200 miles, and might be at the Katanga mines in 1913. The Rhodesian railway should, therefore, serve the mines long before that from Benguela. The latter will, however, not cover more than 900 miles, whereas the Kambove-Beira line is well on towards 1700 miles. To forestall the Benguela railway, and divert the mining traffic to the Congo lines, the article urges the propriety and feasibility of having the lines from Lumbulumbu to Kalengwe available for traffic within four years, and of fixing the railway tariffs at low rates. A new route is suggested by way of the Kasai, the Sankuru, and a 300-mile line from Lusambo to Hell Gate.

AMERICA.

The Trade of Newfoundland.—An official "Report on the Foreign Trade and Commerce of Newfoundland, 1905–6," shows that the commercial progress of the colony continues to be well maintained. The total external trade in 1905–6, equalling over £20 per head of a population of 230,000, marks an advance of 116 per cent. on that of 1897–8. During the last seven years the balance of exports over imports totals over eight million dollars. The powerful markets nearer home are, however, steadily withdrawing the trade of the colony from the United Kingdom. Engrossing

38 per cent. of the Newfoundland trade in 1888, Britain's share in 1905–6 had fallen to 19·2 per cent. Simultaneously with a shrinkage of 23½ per cent. in the United Kingdom's total trade with Newfoundland from 1888 to 1905–6, Canada increased her trade 106·2 per cent., and the United States 150·4 per cent. From the first place as an importer into the colony the United Kingdom has dropped to a bad third, Canada also having fallen behind the United States in 1905–6. Distilling no spirits, Newfoundland imports only 0·354 of a gallon per head, by legitimate channels at least. Among the imports of 1905–6, 3½ million dollars are set down to farm products—a very considerable part of which might be produced at home. Possessing minerals and valuable forests, the land is credited with excellent pasture and vegetables, and (probably) the ability to mature cereals. Its dominating characteristic, however, continues to be its codfishery, which for centuries has been a bone of contention to rival nations. The fishery still rises steadily in value. During the four years ending 1905–6, the products of the cod fishery made up 65·9 per cent. of the total exports, and in 1905–6, 68 per cent. Good and bad series of years seem to alternate in irregular cycles. Thus eight fat years, 1879–86, were followed by eight lean years, 1887–94. During the last four years there has been a serious falling off in the Bank fishery. The Bank has long been prized by foreign nations, not only as a fishing-ground but also as a training ground for seamen. Rather than permanently employ them in the navy, France has preferred paying large bounties to her Bank fishermen. The revolution, however, in the working of modern ships of war seriously reduces the value of the Bank as a seamen's training school. To Newfoundland itself may therefore before long be resigned her proper geographical share in the Bank fishery.

Natural Mounds in the United States.—Attention was called in the *Journal* for August, 1905, to a discussion which had been carried on in the pages of *Science* respecting the small mounds which form so characteristic a feature in various parts of the United States, particularly in the plains of the region bordering the Gulf of Mexico. The discussion has since been continued, both in *Science* and other publications, without any general agreement being arrived at regarding the cause of the phenomenon. In connection with this discussion, Prof. W. H. Hobbs, who has lately made some valuable contributions to the study of earthquakes, calls attention, in the *American Journal of Science* for April, 1907, to the important part which may be played by earthquake shocks as a contributory cause of some, at least, of such mounds. After noting that one observer, Mr. A. C. Veatch, lays stress on the difference in the composition of the mounds from that of the surrounding ground, he points out that the Gulf plain region is one of notable seismicity, and that sand and water fountains, as well as mud volcanoes, with their products —sand or mud cones and craterlets—are almost universally produced in connection with great earthquakes. The immediate cause is, he points out, the extensive derangement of the ground water during earthquakes, a subject which has not yet received the attention it deserves. On the theory that earthquakes are associated with the displacement of crustal blocks or compartments, a natural result of an earthquake will be the squeezing out of water from the trunk channels of circulation within those districts where blocks are depressed—the contrary movement leading to a sucking down of the water. Among other phenomena of a parallel character, instances are quoted of the formation of funnel-shaped pipes of sand brought up from lower levels, or of sandstone dykes where the material has welled up through the entire length of a fissure. The mud-lumps constantly forming in the Mississippi delta are ascribed to a similar cause, while the so-called mud volcanoes of Minbu and elsewhere are held to be another instance of the same action, having really very little in common with volcanic phenomena. Prof. Hobbs

believes that wherever sand or mud cones are now forming, orographic blocks are being depressed, as is frequently the case at the deltas of great rivers. The Gulf plain mounds are probably aligned upon underground fissures and their intersections, and their more careful mapping may throw some new light on the hidden fissure-system in that region. In connection with Prof. Hobbs's paper, reference may be made to Mr. Schwarz's note on 'Natural Mounds in Cape Colony' (*Journal*, January, 1906). In this case the same difference in composition between the mounds and the neighbouring areas is recorded, while the observation of many sand fountains suggested to the writer a possible aqueous origin for the hillocks.

Structure of the Mexican Plateau.—Mr. R. T. Hill gives some notes on the tectonic history of the Mexican Plateau while describing, in *Science* for May 3, 1907, the geology of the Sierra Almoloya—a long, narrow range rising 1500 feet above the surrounding plain, or 6500 feet above the sea. This sierra consists mainly of stratified limestones of Lower Cretaceous age, which have been greatly tilted and thrown into a most complicated system of folds, though, taken as a whole, the strata dip conformably with the slope in every direction, giving the range a quaquaversal character. It is a destructional or decadent form of mountain, revealing the ancient wrinkled and folded character of the plateau before it was buried by the vast volcanic outpourings which once covered the whole of this part of Mexico. The limestones are in places completely metamorphosed and are now excessively fractured, two distinct systems of faulting being discernible. Mr. Hill traces two corresponding periods in the geological history of the region: the first at the close of the Cretaceous period, at the time of the great Rocky mountain uplift and union of the North and South American continents, when the trend of the folds and faults was north-east or from north to south; the other probably during the Miocene epoch, when the great volcanic ejections took place, the whole structural trend now changing to N. 40° W. It was during this second period that the great mineral lodes of Mexico were mostly intruded, through the medium of hot vapours, waters, and gases, up the north-westerly fault-zones. It appears as though the whole of this region has been the site of the crux of two distinct periods of mountain-making movements, and by the hypothesis of the crossing of the two belts of deformation many hitherto obscure phenomena of the continent may be explained. Further study, Mr. Hill thinks, may show that the post-Miocene belt of north-west to south-east movement may extend from California across Mexico, and connect with the Antillean movements of the West Indies.

Mexican Isthmus Railway.—A Consular Report (Miscellaneous Series, No. 658) treats of the history, present position, and probable prospects and bearing on the commerce of the world, of the Tehuantepec railway and its two terminal harbours opened for traffic last January. The work on the harbours will probably not be finally concluded till 1909. Yet, like the railway, apparently of the most solid workmanship, they are so far advanced as to admit of the entrance of large ships, and the speedy handling of freight. From port to port it is only 125 miles in a bee-line, but the route followed by the railway covers 190 miles. From the mouth of the Coatzacoalcos the railway gradually ascends till, at 79 miles, it shoots over the steel bridge, 560 feet long, spanning the Jaltepec river. Thence, by a steeper gradient, it runs 38 miles to Malatengo cañyon. Here the route is through rock cuts and bridged chasms, climbing to Rincon Antonio, 900 feet high, a healthy spot, where the company's yard and shops are established. Next the Chevela pass, 735 feet high, is crossed by gradients reaching 116 feet to the mile. The descent thence to the Pacific includes the steepest gradients. Following for some distance the course of the Tehuantepec river, the route leaves it before its terminus at Salina Cruzo. Connected with Vera Cruz and the Pacific railroad, the

railway gives access to all parts of the Republic, and to the United States, while its junction with the Pan-American line will give direct railway access to the Central American Republics. The magnitude of the influence likely to be exerted by the new railway on the highways of the world's commerce may be gathered from a table, embodied in the report, of comparative distances of the various routes from the principal ports of Europe and the United States to ports on the Pacific. The distance, *e.g.*, from New York to Hong Kong is 1351 miles, and to San Francisco 1200 miles, shorter by the new railway than by way of Panama.

AUSTRALASIA AND PACIFIC.

A Visit to the Ke Islands.—Captain Pim, one of the members of the Daniels ethnographical expedition to New Guinea, has lately made a trip to the little-visited Ke group, some notes on which, mainly of ethnographical interest, he has communicated to Dr. Seligmann, who has kindly placed the letter at our disposal. The writer had been engaged in "shelling" for a commercial company in the neighbourhood of the Aru group, whence he found it necessary to proceed on business to Ke. Rounding the south point of the principal island he coasted as near to the shore reef as possible to Ellat, the headquarters of the Dutch "Post-holder." Many little villages were passed, between which good roads had been cut over the rocky points which separated them. The hills and mountains (apparently limestone) were clothed with the most luxuriant vegetation, no patches of barren ground being seen. Ellat is the seat of a native pottery industry, supposed to have been brought hither generations ago by fugitives from Banda. Here the people were mostly of Malay blood, but Captain Pim made an excursion to an inland village on the south-east or windward side of the island, where the people were of Papuan race. The path was exceedingly rough, and the village was placed on a precipitous hill some 1000 feet above the sea. *En route* some "tabu" marks were seen recalling those in use at Waima, in New Guinea, and a couple of parallel stone walls were passed which were said in old days to mark a strip of neutral ground between two clans or tribes. At one part of the ascent of the hill a rude flight of steps had been constructed of flat stones, some of great size, and the central part of the village itself was surrounded by a wall of from 14 to 20 feet in height, admittance being through an opening reached by a wooden ladder. Captain Pim found the people preparing a coffin from the trunk of a tree split in two, the workmanship (performed by the help of adzes, axes, and a sort of draw-knife) was remarkably neat. The clothing of most of the people was only the mat of native manufacture, such as is seen in parts of New Guinea, and even this seems only to have been adopted of late years, though both men and women wear many ornaments. The hair was long, and frizzled after the New Guinea fashion, but two distinct types, one stiff and wiry, the other softer and longer, were noticed. The people seemed to be agriculturists, and the matriarchal system prevails among them. Captain Pim hopes to revisit the group after improving his knowledge of Malay, having been much hampered by the want of a suitable interpreter.

POLAR REGIONS.

The Wellman Airship Expedition.—Mr. Wellman left London on May 24 *en route* for Spitsbergen, whence he hopes this year to start on his adventurous airship voyage for the north pole. He was to collect his party at Tromsoe, sailing thence in the *Frithjof* early in June, and hoped, after preliminary trials, to make the final start towards the end of July, or early in August. The airship, which had preceded him to Tromsoe, has been subjected to some alterations since last year. The balloon has been made 18 feet longer, and now measures 184 feet in

length by 52 feet at its greatest diameter, with a total lifting force of 19,500 lbs. Arrangements have been made to use the surplus hydrogen gas, which is usually allowed to escape, as a subsidiary fuel-supply for the motor; and another novel device is that of a leather trailing-rope, 15 inches in diameter and 130 feet long, which can be packed with 1200 lbs. of reserve food. Altogether, the party takes supplies for ten months, and has with it twelve dogs, with sledges and small boats for use in case the voyage has to be interrupted. Mr. Wellman is again accompanied by Major Hearsey, lent by the United States Government as scientific observer, while the navigator is Felix Reisenberg, who spent last winter at the base in Spitsbergen with two Norwegian companions.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Ice and River Erosion.—Prof. Brunhes, one of the younger French geographers who has lately become known for several useful pieces of research work, has contributed one or two notes to the *Comptes Rendus* of the Paris Academy of Sciences on the subject of glacial, as compared with other forms of erosion. In one of these (*C.R.*, June 5, 1906), he laid stress on the special action of the sub-glacial streams which tends to make itself most felt at the two sides of the glacier-bed, thus favouring the production of the typical U-shaped section. In a more recent note (*C.R.*, April 29, 1907) he insists on the close analogy which is displayed, in spite of the general belief to the contrary, between the morphological features of glaciated and stream-eroded valleys, so long as the latter are in a youthful stage of development. Thus, while it is often said that water can only move on the down grade, while ice can surmount obstacles, he points out that the distinction is far less important than is supposed. In the case of a hollow excavated by a river in the concave part of its bend, this is not filled with stagnant water, but is only maintained by the scouring of its bed by the current, the water afterwards mounting the up-grade in its further course. The steps in the longitudinal profile of a glacial valley, the closed contours, the U-shaped section, and even the want of accordance at the junction of tributary valleys, are all to be matched in the case of erosion by running water if we consider the form, not of the water-surface, but of the ground fashioned by the water. The fall of the Rhone water into the general mass of the Lake of Geneva at the extremity of its delta is, Prof. Brunhes shows, but the expression and result of a veritable "Mündungstufe." He has elsewhere insisted on the importance of whirlpool action in water-erosion, and it is just this which is lacking in the case of ice, though present in the sub-glacial streams.

The Idea of Direction in Relation to Rivers.—It is evident that the idea of direction, applied to the course of a river as a whole, must be more or less indefinite and capable of various special interpretations, the only direction that is definitely fixed being that in a straight line from the main source to the main mouth. In a paper in the *Rivista Geografica Italiana* for February, 1907, Prof. A. Issel makes some suggestions with a view to the acceptance by geographers of certain conventions in respect to the direction of rivers, which, he thinks, may be of use in comparing the course of a river with the structural lines of its basin, or similar studies. He proposes the three terms "absolute," "dominant," and "mean direction" to denote (1) the direction from source to mouth of a river; (2) the direction which occurs most frequently during the windings of its course; (3) the mean of the partial directions obtained by dividing up the course of the river into small equal sections. This last is found by taking the diameter of the parallelogram constructed with a pair of partial directions as adjacent sides (the lengths being determined by the comparative frequency of the given directions), and using

this in combination with a third partial direction, and so on. In order to simplify the process, Prof. Issel reduces all the partial directions to definite points of the compass—sixteen or thirty-two according to the degree of accuracy required—and he shows the results diagrammatically by the help of a compass-rose, on which the directions and their comparative frequency are shown by a series of radiating lines of varying lengths. As partial directions of one and the same stream may in certain cases be exactly opposite, it may be impossible to obtain a single "mean direction," and the writer therefore determines a series of mean directions corresponding to the four quadrants of the circle, which, however, will rarely be all represented in one special case. The extent to which the arbitrary element enters into the method is recognized by the writer. Thus very varying results are obtained according to the scale of the map employed, and the degree of minuteness to which the division into segments is carried; and it is suggested that terms should be employed to indicate the degree of accuracy obtained. It may be noted that much will also depend on the width of the river under examination, for it is evident that in the case of a wide river, fewer curves will be missed in a small-scale map than when the stream is narrow. Even if some such system may be of use for the comparative purpose above alluded to, it may be doubted whether any instructive result can be gained by dealing at once with the whole course of rivers (such, *e.g.*, as the Nile or Brahmaputra), which traverse great distances, and cross regions of varying structure and characteristics. The paper is illustrated by a number of diagrams constructed to represent the various directions of the Arno, but there are one or two points not fully explained. Thus, it is puzzling to find the "absolute direction" of the river given as one point north of east (which is that from the *mouth* to the *source*), with the comment that it is almost the reverse of the "dominant" direction. Again, we find a diagram in which no fewer than ten "dominant directions" are shown, some of them entirely unrepresented in the rose of partial directions shown in juxtaposition. The writer makes no attempt to work out a comparison between river-directions and other features, beyond pointing out that in one case the mean directions of the Arno work out as three in number, two exactly opposite and corresponding with the main Apennine water-parting, the third at right angles to this.

GENERAL.

Dr. Krause as Geographer.—The position of geography in Germany in the early part of last century is illustrated by a monograph by Dr. A. Köhler (Leipzig, 1905), summing up and criticizing the geographical views of Dr. C. C. F. Krause. A notable scholar, Dr. Krause, thanks to his unpractical ways and the opposition he provoked, did not succeed in obtaining a professorship, but from 1802 to the end of his life had to work on the scant economic basis of the office of *Privatdocent*. More appreciated after his death, fifty volumes of his works have now appeared, and apparently the task is not quite completed. For an adequate representation of geography as conceived and formulated by Krause the reader must consult the monograph of ninety-four pages. Geography was not Krause's speciality, and the writer recognizes that, in this field, he produced nothing strikingly original; but, following up the ideas of Kant, Schelling, and Herder, was reproductive more than productive. He was, above all, a philosopher, bent on reducing everything to first principles. He inclines, therefore, to impose on geography the method and terminology proper to philosophy. Aspiring after a "primitive German" terminology, his nomenclature is imperfectly intelligible even to Germans. Yet idealizing geography, he exercised a not inconsiderable quickening influence on the science, and scattered among his writings are shrewd geographical intuitions.

For Krause geography is a natural science, and an independent one, requiring, however, for its comprehension a knowledge, among other things, of political history, and of the reciprocal history of the Earth and Man. He is said to have been the first to recognize Europe as a mere peninsula of Asia. He also pointed out the correspondence between Italy and Sicily on one side, and Great Britain and Ireland on the other.

OBITUARY.

Sir Dietrich Brandis, F.R.S.

The Society has lost a Fellow of forty years' standing in Sir Dietrich Brandis, well known for his excellent work in connection with forestry in India. The son of Dr. Christian Brandis, a professor at Bonn University, he was educated at Copenhagen, Göttingen, and Bonn, at which last university he became lecturer on botany in 1849. In 1856 he entered the Indian Forest Service, and soon did good work as superintendent of the forests of Burma. In 1864 he became Inspector-General of the Forests of India, a post which he continued to fill until his retirement in 1883. Since that date he continued to take a warm interest in everything connected with Indian forestry, the cause of which he furthered both by his writings and in connection with the forestry school of Cooper's Hill. Only last year he brought out an excellent handbook on Indian trees, intended primarily as an aid to forest officers in the task of making themselves acquainted with the trees under their charge. The preparation of this had involved a large amount of work, rendered more trying by the author's advanced age and failing health. He died on May 28, after six months' illness, at his old home of Bonn on the Rhine, aged eighty-three years.

Dr. E. J. Routh, F.R.S.

The well-known Cambridge tutor, Dr. E. J. Routh, whose pupils so many of the senior wranglers of the latter half of the nineteenth century were proud to avow themselves, died early in June at Cambridge, where he had continued to live after his retirement from work as a teacher in 1890. He had joined our Society in 1864, and had thus been a Fellow for no less than forty-three years. He was a man of wide interests, not by any means confining his attention to his own particular subject, and his sympathy was always with the efforts of the Society to improve the position of geographical education in this country, especially at his own University. Dr. Routh was born in Canada in 1831, being the son of Sir Randolph Routh, Commissary-General to the Forces in the Dominion. He came to this country at an early age, and was educated at University College, London, and Peterhouse, Cambridge, of which college he became a Fellow after appearing at the head of the Mathematical Tripos in 1854.

Captain J. Buchan Telfer, R.N., F.S.A.

We regret to record the death, at the age of seventy-six, of Captain J. B. Telfer, R.N., who had been a Fellow of the Society since 1875. Captain Telfer had seen much naval service, having taken part in the Crimean war (gaining the Baltic medal), besides serving on many of the naval stations abroad.

He subsequently married a Russian lady, and resided, about 1870, for three years in Russia, visiting on two occasions the Crimea and the Caucasus, and making extensive journeys through the mountain districts. His knowledge of Russia, and

his antiquarian and historical tastes, enabled him to add largely to the account of Suanetia previously given in Mr. Freshfield's 'Central Caucasus.' His work in two volumes, 'The Crimea and Transcaucasia,' published in 1875, has a permanent value as a mine of curious information and an accurate description of Transcaucasia at that date.

OBITUARY OF THE YEAR.

The following is a list of the Fellows who have died during the year 1906–1907 (April 30):—

T. E. L. Alldridge; A. Alexander; Lord Allandale; Rev. Chas. J. Armistead; Claude L. Barrow; Captain Maurice D. Bell; P. W. Braybrooke; Clifford J. Brookes; E. W. Briggs; Count De Bylandt; Captain W. E. Bentley; Sir Richard Couch; J. R. Cossar; Donald Cameron; H. W. Chubb; J. W. Carillon; H. W. Cadoux; Rev. J. J. Curling; J. A. Campbell; Rev. Dr. J. N. Cushing; Count H. Coudenhove; G. H. Drew; D. R. Dickson; K. Dunbar-Anderson; Colonel E. S. Daniel; F. G. S. De Wesselow; G. E. Dodson; John Dickson; G. F. Edwards; Robert Edleston; Captain H. C. Keith Fraser; Sir John Forbes; Admiral Sir E. Fanshawe; R. I. Fennimore; Rev. G. Grenfell; J. S. Greenhalgh; Lord Goschen; George Gordon; W. T. Hansford; R. A. Hankey; Edward Herdman; A. F. Howard; J. Stewart Hodgson; Arthur F. Herbert; David Hepburn; C. Kennerley Hall; J. F. Jones; John Jupe; Mrs. E. P. Jackson; James Irvine; H. R. Knott; G. B. C. Leveson; Major E. Le Mesurier; The Earl of Liverpool; G. J. L. Litton; William Marshall; John Moore; Sir Walter Morgan; Basil Martineau; Captain D. Mainland; W. R. McConnell; Ivan A. Morris; J. G. Don Marshall; W. A. Mitchell; F. A. Morgan; Rev. Canon Maccoll; Colonel Iles Matthews; Sir Hugh Nelson; Rev. J. O. Oxland; John Prince; Inspector-General E. R. H. Pollard; Henny Prince; Sir F. Plunkett; Lord Penrhyn; J. A. O. Payne; J. Grafton Ross; Major F. I. Ricarde-Seaver; F. W. Raikes; James Holland Robertson; M. A. Raquez; Colonel F. R. Waldo-Sibthorp; Admiral Sir F. W. Sullivan; W. H. Stuart; Rev. Dr. James Stewart; General Sir H. A. Smyth; T. Valentine Smith; Colonel C. F. Surtees; Christopher Barker Smith; W. J. J. Spry; Robert Scott; Horace Smith-Bosanquet; Robert Taylor; Sir H. E. L. Thuillier; W. A. Tully; Sir R. Tangye; Lord Thring; Admiral Sir R. Tracey; James Vavasseur; Dr. C. R. Walker; Rev. F. A. Walker; Alfred Williams; John Weise; Stephen White; Allan Wyon; W. Clarence Watson.

CORRESPONDENCE.

Levels of African Lakes.

Entebbe, April 29, 1907.

In connection with a recent paper read by Lieut. Behrens, R.E., before the R.G.S. on the levels of African lakes, it may be of interest to inform you that a complete chain of levels was run with 16-inch dumpy level between Lakes Victoria and Albert by one of the surveyors of this department (Mr. E. Richardson) some months ago, and this gave a difference of level to the nearest foot between the lakes of 1692 feet. As only one observer was employed, and no check levels were run, the figures are not absolutely reliable, but are more so than any previous figures I have seen.

Raymond E. Allen, F.R.G.S., Ch. Surveyor, U.P.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1906–1907.

Anniversary Meeting, May 27, 1907.—The Right Hon. Sir GEORGE TAUBMAN GOLDIE, K.C.M.G., F.R.S., D.C.L., LL.D., in the Chair.

THE Secretary read the Minutes of the last Anniversary Meeting, which were confirmed and signed by the President.

The Secretary read a list of the newly elected Fellows, and announced that there were five candidates for election.

ELECTIONS. — *William Delabere Barnes; Charles Edward Moss; E. R. Murphy; Basil Tanfield Beridge Boothby; Major E. P. Brooker, R.E.; Douglas Graham Campbell; Lieut.-Colonel John Lloyd Dickin; Dennys Drake; Ernest John Edwards; Ernest Alfred Glanville; Captain C. W. Gordon* (*5th Fusiliers*); *M. Y. Hsu, B.A.; Colmer William Donald Lynch; John William Page; George Roger; Vivian Lee Osborne Sheppard; Philip Small; Captain Maurice E. Sowerby, R.E.; Rev. Chas. Edward Wilson; F. R. Wollaston; John Wm. Young.*

THE PRESENTATION OF THE MEDALS AND OTHER AWARDS.

The PRESIDENT: Dr. Francisco Moreno, to whom has been awarded the Founder's Gold Medal, expected to have been able to come here from South America and receive it himself, but at the last moment he was prevented from doing so, and he sent a cablegram to that effect. The Argentine Minister has been good enough to ask his brother, Sr. D. Carlos Diminguez, who is a member of the Legation, to attend here and receive it on behalf of his brother. I will read the minute of the Council on the award of the Medal—

"Dr. Francisco Moreno is one of the foremost scientific geographers of the day. For more than twenty years he has been personally occupied in the work of South American exploration. Patagonia and the Southern Andes have been his peculiar field, and in the prosecution of his work in the field he has encountered unusual risks, having been captured by the Indians once, and barely escaping with his life. As a scientist his reputation is European. He was the expert employed by the Argentine Government on the Chile-Argentine boundary question, and it is to him that we owe nearly all our knowledge of the physical geography of the extreme south of South America. He still continues his active interest in all geographical enterprise. He has now a geographical school under him, and they are studying the science very thoroughly."

Sr. CARLOS M. DOMINGUEZ: I have been deputed by the Argentine Minister, who is unavoidably prevented from attending the afternoon meeting, to receive, on behalf of Dr. Don Francisco P. Moreno, the Royal Founder's Medal, with which he has been honoured by the Council of the Society. Dr. Moreno wishes me to express his heartfelt thanks to this Society for such great distinction bestowed upon him; and, if I may be allowed, I desire to add, as an Argentine citizen, the gratification of my compatriots in seeing a fellow-countryman so highly honoured by the premier geographers of the world.

The PRESIDENT: His Excellency, the Norwegian Minister, Dr. Nansen, has been good enough to undertake to transmit to Captain Amundsen the Patron's Gold Medal, which was awarded to him by the Council.

Your Excellency, I will read to you the Minute of the Council on which they based the award to Captain Amundsen, although I am quite sure you could tell us very much better what Captain Amundsen has done—

"Captain Amundsen went first on a sealing expedition to the Arctic Regions, to

learn navigation and to prepare himself for Arctic exploration. He then served as first lieutenant on board the *Belgica* in the Belgian Antarctic Expedition. On his return he devoted himself to master the subject of terrestrial magnetism, placing himself under the tuition of Dr. von Neumayer, of the Hamburg Observatory, in order that he might qualify himself for his projected work around the north magnetic pole. After purchasing his ship, the *Gjöa*, he spent some time exploring the ocean between Spitsbergen and Greenland, making valuable contributions to oceanography, which have since been worked out by Dr. Nansen. He sailed for the region around the north magnetic pole in 1903, in his small ship, with eight men all told, all of them more or less specialists. He devoted two years to careful observations, with the best instruments, round the north magnetic pole, making contributions of the first order to our knowledge of geographical distribution of magnetism. During the stay of the expedition in the neighbourhood of Boothia, several expeditions were made in various directions. A large section, hitherto unmapped, of the North American coast was mapped, and much other geographical work done in the neighbouring islands, and careful observations were made on the Eskimo, among whom the expedition lived. At the conclusion of the magnetic work the little ship was taken out by Behring straits, and thus for the first time the North-West Passage was completed in a vessel. Altogether, Captain Amundsen deserves to be placed in the first rank as a scientific discoverer."

His Excellency Dr. NANSEN: I have to regret deeply that Captain Amundsen was not able to be present here to-day in order to receive this great honour in person. He has asked me to do it in his place, and to express his deep gratitude for the great distinction which has been conferred upon him. I am thanking you in his name, and also on behalf of my own country, for this distinction, coming from an institution of a country which has done nearly all the exploring work in that region where he went just to give the finishing touch. It was you who first discovered the magnetic north pole; from you we have all the knowledge of those important regions; but I hope the fact that a Norwegian was allowed to complete the work more or less is a new tie between the country which I have the honour to represent and your own great empire. I again thank you on behalf of Captain Amundsen and on behalf of Norway for the great honour you have bestowed upon him.

The PRESIDENT: The Murchison Award for 1907 was made to Major C. E. Smith, R.E., for his various important surveys in British East Africa, carried out with admirable efficiency. Major Smith, as many of you know, has returned to Africa on very important survey work, so that he is not able to receive it himself, but I understand that one of his brothers is willing to receive it for him. I now have the honour to present the award.

Mr. A. H. SMITH: My brother, as you have said, is far out of reach of this meeting. He is back in the East Africa Protectorate, carrying on the work which he did in previous years, and I can assure you it is a great encouragement to him in his work to know it is approved by the skilled judgment of this Society. He highly appreciates the honour, and I beg to tender his sincere thanks.

The PRESIDENT: Mr. Raymond Beazley, the Gill Memorial for 1907 is awarded to you for your work in three volumes on the 'Dawn of Modern Geography,' the results of many years' research, at your own expense, into the progress of geography and exploration from the early centuries of the Christian era down to the Middle Ages. The work will be of permanent value to all students of geography.

Mr. RAYMOND BEAZLEY: I can hardly say how much an honour of this sort encourages one who has, I hope, not finished his work in this field, to go and, if possible, to do better than he has done before. It has the sanction of that body in

the world which is most dear to my heart, and which most of all encourages me to try and go forward in the work that I have begun.

The PRESIDENT: Mr. Moss, the Back Bequest for 1907 has been awarded to you for your important researches on Geographical Distribution of Vegetation in England, as embodied in your paper on the "Peat Moors of the Pennines," in the *Journal* for 1904, and in a paper on the "Geographical Distribution of Vegetation in Somersetshire," with map, published as one of the extra publications of the Society. You carried out this work at your own expense during your holidays.

The PRESIDENT: Major C. W. Gwynn, you have been awarded the Cuthbert Peek Grant for 1907. In 1899-1900 you carried out an important survey expedition from Roseires, on the Blue Nile, in a southerly direction down to Sobat or Baro river. Between 1900–1901 you conducted an expedition yielding important geographical and cartographical results along the proposed Sudan-Abyssinian frontier.

The President then delivered his anniversary address (see p. 1).

After the visitors had withdrawn, the President appointed as scrutineers of the ballot for Council Mr. G. G. Chisholm and Mr. W. M. Corner.

The Report of the Council was then read; it will be published in the next Year-book.

The PRESIDENT: I have to announce on the report of the scrutineers that the lists sent round on the Council's recommendation have been accepted.

The list is as follows, the names of new members, or of those changing office, being printed in *italics*:—

President: Right Hon. Sir George D. Taubman Goldie, K.C.M.G., F.R.S., D.C.L., etc. *Vice-Presidents*: Sir H. E. G. Bulwer, G.C.M.G.; *Sir Harry H. Johnston*, G.C.M.G., K.C.B.; Right Hon. Lord Curzon of Kedleston, G.C.S.I., G.C.I.E., etc.; Douglas W. Freshfield; *Colonel Sir Colin C. Scott-Moncrieff*, R.E., K.C.M.G., K.C.S.I.; Sir Clements Markham, K.C.B., F.R.S., F.S.A. *Treasurer*: Edward L. Somers Cocks. *Trustees*: Right Hon. Lord Avebury, D.C.L., F.R.S.; Lord Belhaven and Stenton. *Hon. Secretaries*: Major Leonard Darwin, R.E.; *Colonel Sir D. A. Johnston*, K.C.M.G., C.B., R.E. *Foreign Secretary*: Sir John Kirk, K.C.B., G.C.M.G, F.R.S. *Councillors*: Admiral Sir Nathaniel Bowden-Smith, K.C.B.; *Colonel G. Earl Church*; Major Chas. F. Close, C.M.G., R.E.; *Sir Martin Conway*, M.A., F.S.A.; *Admiral A. Mostyn Field*, F.R.S.; *J. Stanley Gardiner*, M.A.; *Sir David Gill*, K.C.B., LL.D., F.R.S.; Sir Clement L. Hill, K.C.M.G., K.C.B., M.P.; Colonel Sir Thomas Hungerford Holdich, K.C.I.E., C.B., R.E.; *James F. Hughes*; Sir George S. Mackenzie, K.C.M.G., C.B.; Admiral Sir Albert Hastings Markham, K.C.B.; John L. Myres, M.A.; Right Hon. Sir J. West Ridgeway, G.C.M.G., K.C.B., K.C.S.I.; *Earl of Ronaldshay*; Howard Saunders, F.L.S.; *Dr. Aubrey Strahan*, F.R.S.; Colonel Hon. M. G. Talbot, R.E.; H. Yates Thompson; Professor W. W. Watts, F.R.S.; Colonel C. E. Yate, C.S.I., C.M.G.

THE ANNIVERSARY DINNER.

The Anniversary Dinner took place in the evening at the Whitehall Rooms of the Hôtel Métropole. Sir George Goldie, the President, was in the chair, and among those present were the American ambassador, the Italian ambassador, the Argentine minister, the Norwegian minister, the Vice-Chancellor of Oxford, the Vice-Chancellor of Cambridge, the Principal of the University of London, Sir J. West Ridgeway, General Sir Reginald Talbot, General Sir Frederick D. Lugard, General Sir A. Lyttelton-Annesley, the Earl of Camperdown, Admiral Hon. Sir E. R. Fremantle, the Premier of Victoria, Sir Colin Scott Moncrieff, Lord Eustace Cecil, Sir Harry Johnston, Admiral Sir Albert Markham, Sir Thomas H. Holdich, Sir Henry E. G. Bulwer, Admiral A. Mostyn Field, Admiral Sir N. Bowden Smith, Sir George S. Mackenzie, Hon. George Peel, Sir Henry Trotter, Sir Thomas Fowell

Buxton, General Sir Edward Hutton, Sir James Hayes Sadler, Mr. Yates Thompson, Dr. H. H. Guillemard, General Shaw-Stewart, General J. C. Dalton, Mr. D. G. Hogarth, Mr. J. L. Myres, Colonel G. E. Church, Captain H. G. Lyons, Sir Alfred Sharpe, Major Powell-Cotton, Lieut. Boyd Alexander, Dr. C. Chree, Colonel Sir Duncan Johnston, Mr. J. F. Hughes, Mr. E. L. S. Cocks.

After the toasts of "Our Patron, the King," and "Our Vice-Patron, the Prince of Wales," the PRESIDENT proposed the toast of "The Navy and the Army," to which Admiral the Hon. Sir E. R. Fremantle and General Sir A. Lyttelton Annesley replied.

The PRESIDENT then proposed the toast of "The British Empire," which was responded to by the Premier of Victoria, by Sir Frederick Lugard, Governor of Hong Kong, and by Mr. Frank Tate, Director of Education in Victoria.

The toast of "The Guests" was proposed by the PRESIDENT, and responded to by the Italian ambassador and the Vice-Chancellor of Oxford.

Sir THOMAS HOLDICH proposed the toast of "The Medallists," which was responded to by the Argentine minister and the Norwegian minister.

The toast of "The Society" was proposed by the Vice-Chancellor of Cambridge, and responded to by the PRESIDENT.

Fourteenth Meeting, June 10, 1907. The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

The paper read was:—

"On the Influence of Ice-melting upon Oceanic Circulation." By Dr. Otto Pettersson.

Fifteenth Meeting, June 17, 1907. The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—*Henry Gloster Armstrong; Walter Samuel Ascola; Wm. Benstead; Ernest Francis Bowen; Charles Stewart Burnett; Frank Wright Cluny; Prof. G. C. Carrington-Craxton; Francis Hill Cobb; A. H. Gehrke; Major W. Gillman, D.S.O., R.A.; Herbert Le Gren Harrison; David Ernest Hutchins; Walter J. Jones; Major K. McLaren, D.S.O.; Malcolm Maclaren; Captain H. Walter G. Meyer Griffith; E. S. Morphew; Captain Henry George Charles Perry-Ayscouth (Inniskillen Fusiliers); William Peterson, Edward Arthur Read; Charles Henry Rosher; Malcolm Ross; David Dunn Stewart; W. M. Strong, M.A., M.D.; George Henry Tatterfield; Colonel Wentsai Shu Yun Tinge; Charles Hay Walker; Wilfred Watkins; Wm. Donald Paul Watson; Wm. Baker White; George Nigers Worthington, M.B., B.C., M.A.*

The paper read was:—

"In the Equatorial Forests of Africa." By Major P. H. G. Powell-Cotton.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps—Glaciation. **Nussbaum.**

Die eiszeitliche Vergletscherung des Saanegebietes. Inaugural-Dissertation . . . von Fritz Nussbaum. Bern, 1906. Size 9 × 6, pp. viii. and 230. *Maps and Sections. Presented by the Author.*

Austria—Bohemia. *M. k.k. G. Ges. Wien* **49** (1906): 586–593. **Sellner.**

Geomorphologische Probleme aus dem Hohen Böhmerwalde. Von Dr. Alois Sellner.

Baltic—Ice. *Fennia* **21** (1903–04): No. 1, pp. 170. **Heinrichs.**

Isförhållandena i Östersjön och dess vikar I. Makriel. Af Axel Heinrichs.

Belgium. *B.S. Belge Géologie* **20** (1906): *Mémoires*, 71–82. **Briquet.**

Contribution à l'étude des origines du réseau hydrographique du nord de la Belgique. Par A. Briquet. *With Sketch-maps.*

Central Europe—Hydrology. *G.Z.* **12** (1906): 611–630, 682–699. **Keller.**

Die Abflusserscheinung in Mittel-Europa. Von H. Keller. *With Diagram.*

Europe—Fisheries. ———

Conseil permanent international pour l'exploration de la mer. Bulletin statistique des pêches maritimes des pays du nord de l'Europe. Vol. 1. 1903 et 1904. Copenhagen, 1906. Size 10½ × 8½, pp. 262. *Charts.* [In English and German.]

Europe—Political. *J.R. Artillery* **33** (1906): 346–357. **Maguire.**

The rôle of Poland in modern Europe. By T. Miller Maguire. *With Maps.*

France—Brittany. *Ann. de G.* **15** (1906): 213–236, 299–328. **Martonne.**

La pénéplaine et les côtes bretonnes. Emm. de Martonne. *With Sketch-maps, Illustrations, and Sections.*

France—Nord. *B.S.G. Com. Paris* **28** (1907): 33–42. **Morael.**

Le littoral de la Flandre française: son avenir économique. Par Georges Morael.

Germany—Bavaria. **Messerschmidt.**

Sitzungsber. A.W. München **35** (1905): 69–83; **36** (1906): 545–579.

Magnetische Ortsbestimmungen in Bayern. Von J. B. Messerschmidt. *With Map.*

Germany—Prussian Saxony. *Abh. u. Ber. Museum Magdeburg* **1** (1905–06): 6–41. **Jacob.**

Die geographisch bedingten wirtschaftlichen Grundlagen der Magdeburger Gegend. Von T. Jacob. *With Map and Section.*

Greece—Ithaka. **Dörpfeld.**

Leukas; zwei Aufsätze über das homerische Ithaka. Von Wilhelm Dörpfeld. Athens, 1905. Size 9½ × 6½, pp. viii. and 44. *Maps. Price* 1*s.* 4*d.*

Hungary. **Shrubsole.**

Geographical errors in British school-books. By W. H. Shrubsole. London, 1907. Size 13 × 8, pp. 4. *Illustration.*

A protest chiefly directed against the prevalent confusion as to the political status of Hungary.

Hungary—Bihar mountains. **Szádeczky.**

Abrégé B.S. Hongroise G. **34** (1906): 131–134.

Gletscherspuren in Bihargebirge. Von Dr. J. Szádeczky. (*Földrajzi Közlemények.* **34** (1906): 299–304. *With Illustrations.*

Iceland. *G.Ts., K.Danske G.S.* **18** (1905–06): 283–287. **Jensen.**

Meddelelser om Generalstabens Arbejde paa Island i Sommeren 1906. Af Premierløjtnant P. F. Jensen. *With Illustrations.*

North Sea and Baltic. **Küppers.**

Physikalische und mineralogisch-geologische Untersuchung von Bodenproblem aus Ost- und Nordsee. Von Dr. Ernst Küppers. Kiel, 1906. Size 12½ × 10½, pp. 12. *Maps.*

Norway—Ethnology. *Norge G.S. Aarbog* **17** (1905–6): 145–216. **Hansen.**

De aeldste husformer i Norge. Af Dr. Andr. M. Hansen. *With Illustrations.*

Norway—Trondhjem—Avalanches. **Nissen.**

Norske G.S. Aarbog **17** (1905–06): 217–221.

Et snaeskred i Sundalen. Af Peter L. Nissen. *With Illustrations.*

Russia—Archangel. *Iz. Imp. Russian G.S.* **41** (1905): 571–585. **Rudnev.**

Preliminary Report on the Bolshesemelsk Expedition, 1904. By D. Rudnev. *With Map and Illustrations.* [In Russian.]

Russia—Bibliography. **Friederichsen.**

Europäisches Russland 1894–1905 (mit Einschluss des Kaukasus und Russisch-Armeniens). Von Prof. Dr. Max Friederichsen. Size 8½ × 5½, pp. [60]. *Presented by the Author.*

Russia—Ladoga. *Iz. Imp. Russian G.S.* **41** (1905): 737–754, 755–763. **Hilsen.**

Examination of samples of soils from the southern and central parts of Lake Ladoga. By K. Hilsen. *With Map.*

Materials for the study of the rocks of Lake Ladoga. By the same. *With Maps.* [In Russian.]

Russia—Samara. *Iz. Imp. Russian G.S.* **41** (1905): 283–288. **Volarovich.**

Hypsometric work in the bay of Samara. By P. E. Volarovich. [In Russian.]

Russia—Urals. *Abrégé B.S. Hongroise G.* **34** (1906): 168–174. **Pápay.**

Die Ural-Karte Anton Reguly's. Von Josef Pápay. (*Földrajzi Közlemenyek* **34** (1906): 349–370. *With Map.*)

Reguly was one of the most meritorious pioneers in the Northern Urals. His map appeared in 1847.

Spain. **Hutton.**

The Cities of Spain. By Edward Hutton. London: Methuen & Co., [1906]. Size 9 × 5½, pp. xvi. and 324. *Illustrations. Price 7s. 6d.*

Spain—Tarragona. *C.R.A. Sc., Paris* **143** (1906): 815–818. **Cirera.**

Détermination des coordonnées geographiques de Tortosa et du nouvel Observatoire del Ebro. Note de R. Cirera.

Sweden—Peat-moors. **Post.**

Norrländska Torfmossestudier I. Drag ur myrarnas utvecklingshistoria inom "lidernas region." Af Lennart von Post. (Meddelanden från Upsala Universitets Mineralogisk-Geologiska Institution, 30.) Stockholm, 1906. Size 8½ × 5½, pp. 199–308. *With Maps and Illustrations.*

Sweden—Stockholm. *Ymer* (1906): 273–292. **Larsson.**

Topografiska studier i Stockholmstrakten. Af Adolf Larsson. *With Sketch-maps, Illustrations, and Sections.*

United Kingdom. *Deutsche Rundschau G.* **29** (1906): 1–12, 62–71. **Kirchhoff.**

Die Britischen Inseln und die Briten. Von Prof. Dr. Alfred Kirchhoff.

United Kingdom. **Mackinder.**

Our own islands. An elementary study in geography. By H. J. Mackinder. London: G. Philip & Son, [1907.] Size 7½ × 5, pp. xvi. and 298. *Maps and Illustrations. Price 2s. 6d. Presented by the Publishers.*

United Kingdom—England. **Pocock.**

Memoirs of the Geological Survey: England and Wales. Explanation of Sheet 110. The Geology of the Country around Macclesfield, Congleton, Crewe, and Middle-

wich. By S. I. Pocock. London, 1906. Size 9½ × 6, pp. vi. and 138. *Sketch-maps and Sections.*

United Kingdom—Glacial Epoch. **Lamplugh.**

British Association for the Advancement of Science: York, 1906. Address to the Geological Section by G. W. Lamplugh, President. On British Drifts and the Interglacial Problem. [London, 1906.] Size 8½ × 5½, pp. 28.

United Kingdom—Scilly Isles. **Barrow.**

Memoirs of the Geological Survey: England and Wales. Explanation of sheets 357 and 360. The Geology of the Isles of Scilly. By George Barrow. London, 1906. Size 9½ × 6, pp. iv. and 38. *Map and Illustrations.*

United Kingdom—Scotland—Lakes. **Chrystal and Murray.**

An Investigation of the Seiches of Loch Earn by the Scottish Lake Survey. Part I. Limnographic Instruments and Methods of Observation. By Prof. G. Chrystal. Part II. Preliminary Limnographic Observations on Loch Earn. By James Murray. (From the Transactions of the Royal Society of Edinburgh, vol. **45**, part ii.) Edinburgh, 1906. Size 12 × 9½, pp. [36]. *With Illustrations and Diagrams.*

United Kingdom—Scotland—Perthshire. **Rodger.**

Illustrated Handbook to the Perthshire Natural History Museum, and Brief Guide to the Animals, Plants, and Rocks of the County. By Alex. M. Rodger. Perth, 1906. Size 7 × 5, pp. 88. *Sketch-map, Illustrations, and Sections. Price 3d. Presented by the Curator, Perthshire Museum.*

Western Europe—Erratics. **Wichmann.**

K.A.W. Amsterdam, P. Sect. Sc. **8** (1905-6): 518-535.

On fragments of rocks from the Ardennes found in the Diluvium of the Netherlands North of the Rhine. By Prof. A. Wichmann. *With Map.*

ASIA.

Aden and Perim. **Bartet.**

Souvenirs de crosière dans la mer Rouge. Notes géographiques et historiques sur Aden et Périm. Par le Dr. Bartet. (Extrait du Bull. de la Société de Géographie de Rochefort, 1904.) Rochefort, 1904. Size 10 × 6½, pp. 116. *Presented by the Author.*

Armenia. **Zahn.**

Veröffentl. I. f. Meeresk. u.d. G.I., Universität Berlin, Heft **10** (1906): pp. viii. and 90.

Die Stellung Armeniens im Gebirgsbau von Vorderasien, unter besonderer Berücksichtigung der türkischen Teile. Von Dr. Gustav W. v. Zahn. *With Maps.*

Central Asia—Tian-Shan. **Keidel.**

Geologische Untersuchungen im südlichen Tian-Schan nebst Beschreibung einer obercarbonischen Brachiopodenfauna aus dem Kukurtuk-Tal. Von Hans Keidel. (Separat. Abdruck aus dem Neuen Jahrbuch für Mineralogie, Geologie und Paläontologie; Beilage., Band **xxii.**) Stuttgart, 1906. Size 9 × 6, pp. [120]. *Map and Plates. Presented by Dr. G. Merzbacher.*

Central Asia—Tian-Shan. *Abrégé B.S. Hongroise G.* **34** (1906): 175–186. **Prinz.**

Reiseskizzen aus Centralasien. Von Dr. Julius Prinz. (*Földrajzi Közlemények* **34** (1906): 440–444.)

Chinese Empire. *Petermanns M.* **53** (1907): 16–20. **Tafel.**

Briefliche Mitteilungen von Dr. Alb. Tafel über seine Reise in Zentralasien vom Juli 1906.

These letters supply further details of the traveller's journeys in the region of the upper Hwang-ho and the march thence towards Tsaidam. (See February number, p. 224.)

Chinese Empire—Historical. **Ricci.**

Dott. Ettore Ricci. Par un centenario; 25 Gennaio, 1601–1901. L'Italia nella conoscenza geografica della Cina sopratutto al principio del seicento. Macerata, 1901–4. Size 9¼ × 6¼, pp. 262. *Portrait. Price 5s. 6d.*

Chiefly devoted to the life and work of Padre Matteo Ricci, the Jesuit missionary.

Eastern Asia. **Plate.**

A cruise through Eastern seas; being a travellers' guide to the principal objects of interest in the Far East. By A. G. Plate. (For the Norddeutscher Lloyd,

Bremen.) London: E. Stanford, 1906. Size 8¼ × 5½, pp. 294. *Maps and Illustrations. Price* 6*s. Presented by the Publisher.*

East Indies—Historical. **Heeres.**

Bijdr., Taal-, Land-, en Volkenk., Ned.-Indie, VII. Ser. **3** (1907): pp. xxxii. and 586.

Corpus diplomaticum Neerlando-Indicum. Verzameling van Politieke Contracten en verdere Verdragen door de Nederlanders in het Oosten gesloten, van Privilegebrieven, aan hen verleend, enz, uitgegeven en toegelicht door J. E. Heeres. Erste Deel (1596–1650).

A reprint of treaties made by the successive Dutch East India companies with native rulers, arranged chronologically.

India. **Malcolm.**

Indian pictures and problems. By Ian Malcolm. London: E. Grant Richards, 1907. Size 9 × 5½, pp. xiv. and 294. *Illustrations. Price* 10*s.* 6*d. net. Presented by the Publisher.*

India—Burma. *Records Geol. Surv. India* **34** (1906): 137–147. **Oldham.**

On explosion craters in the lower Chindwin district, Burma. By R. D. Oldham. *With Illustrations.*

India—Delhi. **Hearn.**

The seven cities of Delhi. By Gordon Risley Hearn. London: W. Thacker & Co., 1906. Size 7½ × 5, pp. xiv. and 320. *Plans and Illustrations. Price* 10*s.* 6*d. net. Presented by the Publishers.*

India—Ethnology. *J.S. Arts* **55** (1907): 324–341. **Barnes.**

The Bhils of Western India. By Captain E. Barnes.

India—Ganges. *J.R. Asiatic S.* (1907): 41–48. **Hoey.**

The five rivers of the Buddhists. By W. Hoey. *With Map.*

The five rivers are the Jumna, Ganges, Gogra, Rapti, and Gandak.

India—Himalayas. **Oakley.**

Holy Himalaya: the religion, traditions, and scenery of a Himalayan province (Kumaon and Garhwál). By E. Sherman Oakley. Edinburgh, etc.: Oliphant, Anderson, and Ferrier, 1905. Size 8 × 5½, pp. 320. *Illustrations. Price* 7*s.* 6*d. net.*

India—Kashmir. *B. American G.S.* **38** (1906): 657–682. **Huntington.**

The vale of Kashmir. By Ellsworth Huntington. *With Map and Sections.*

India—Population. *Ann. de G.* **15** (1906): 353–375, 419–442. **De la Blache.**

Le peuple de l'Inde d'après la série des recensements. Par P. Vidal de la Blache. *With Maps and Diagrams.*

Japan. **Honda and Terada.**

Publs. Earthquake Investigation Com., Japan **22** B. (1906): 49–74.

On the geyser in Atami. By K. Honda and T. Terada. *With Diagrams and Illustrations.*

Malay Archipelago—Borneo. **Stolk.**

Ts. K Nederlandsch Aardrijksk. Genoots. **24** (1907): 1–27.

Opsporing van den zwervenden stam der Penjaboeng Poenan's, op de waterscheidung der Barito met de Mahakam en Kapoeas (Midden-Borneo) en October, 1905. Door J. J. Stolk. *With Map.*

On a journey undertaken for the study of one of the wandering tribes of Central Borneo.

Malay States—Survey. **Young.**

Federated Malay States. Report on the Trigonometrical and General Survey Department for the year 1905. [By A. E. Young, 1906.] Size 13½ × 8½, pp. 6. *Presented by the Author.*

Philippines. *La G., B.S.G. Paris* **14** (1906): 343–368. **Deniker.**

Les Philippines sous la domination des Etats-Unis. Par J. Deniker. *With Map.*

Philippines—Historical. **Blair and others.**

The Philippine Islands, 1493–1898. Edited and annotated by E. H. Blair and J. A. Robertson, with . . . introduction and . . . notes by E. G. Bourne. Vols. **36–45**, 1649–1736. Cleveland, Ohio: A. H. Clark Co., 1906. Size 9½ × 6½. *Facsimile Maps and Illustrations. Price* $4 *net per volume.*

Russia—Caspian. *Iz. Imp. Russian G.S.* **41** (1905): 433–457. **Knipovich.**
Sketch of the work done by the Caspian expedition in 1904. By N. Knipovich. [In Russian.]

Russia—Caucasus. *Iz. Imp. Russian G.S.* **41** (1905): 459-505. **Bush.**
Amongst the hills of the Andisk District of Daghestan. By A. N. Bush. *With Illustrations.* [In Russian.]

Russia—Caucasus. *Iz. Imp. Russian G.S.* **41** (1905): 623–682, 683–696. **Markovich.**
In search of Eternal Ice. By V. V. Markovich. *With Illustrations.*
Short report of a journey along the Black Sea shore in the Caucasus, and on the glaciers of Abkhasia (upper course of the river Kodar), with the view to studying the flora and glaciers, made in 1903. By the same. *With Illustrations.* [In Russian.]

Russia—Siberia. *Iz. Imp. Russian G.S.* **41** (1905): 195–233. **Edelstein.**
The Northern and Central Sikhota-Alin. By Y. Edelstein. *With Illustrations.* [In Russian.]
See note in *Journal*, vol. **27**, p. 628.

Russia—Siberia—Lake Baikal. *Naturw. Wochenschrift.* **21** (1906): 721–725. **Arldt.**
Der Baikalsee, ein tiergeographisches Rätsel. Von Dr. Th. Arldt. *With Maps.*

Russia—Siberia and Turkestan. **Saposhnikoff.**
Iz. Imp. Russian G.S. **41** (1905): 697–704.
From Saur to the Dzungarian Alatau. By V. V. Saposhnikoff. [In Russian.]

Russian Central Asia—Bokhara. *Iz. Imp. Russian G.S.* **42** (1906): 39–90. **Edelstein.**
Notes on the Glaciers of the Peter the Great range. By Y. Edelstein. *With Maps and Illustrations.* [In Russian.]

Russian Central Asia—Tian Shan. *Iz. Imp. Russian G.S.* **42** (1906): 91–236. **Lipsky.**
In the mountain regions of Russian Turkestan (Tian-shan). By V. I. Lipsky. *With Maps and Plates.* [In Russian.]

Russian Central Asia. *Iz. Imp. Russian G.S.* **42** (1906): 1–37. **Shkapsky.**
Two trips into the mountains of the Tashkent district. By O. A. Shkapsky. [In Russian.]

Siberia and Mongolia. *Iz. Imp. Russian G.S.* **41** (1905): 23–154. **Komaroff.**
Journey to the Tunkinsk region and Lake Kossogol, 1902. By V. L. Komaroff. *With Map and Illustrations.* [In Russian.]

Turkey—Arabia. **Brünnow and Domaszewski.**
Die Provincia Arabia. Auf Grund zweier in den Jahren 1897 und 1898 unternommenen Reisen und der Berichte früherer Reisender beschrieben von Rudolf Ernst Brünnow und Alfred v. Domaszewski. Erster Band; Die Römerstrasse von Mâdebâ über Petra und Odruh bis El-'Akaba. Zweiter Band. Die äussere Limes und die Römerstrassen von El-Ma'an bis Bosra. Strassburg: Karl J. Trübner, 1904–1905. Size 13 × 10, pp. (vol. 1) xxiv. and 532; (vol. 2), xii. and 358. *Maps, Plans, and Illustrations.* *Price* (vol. 1) *M.* 80; (vol. 2), *M.* 60.
Mainly concerned with antiquities, but indispensable for any thorough study of the historical geography of the region.

Turkey—Arabia—Yemen. *Riv. Coloniale* **2** (1906): 66–86. **Rossi.**
Nell' Jamen; impressioni di viaggio, note e ricordi. D. G. B. Rossi. *With Map and Illustrations.*

Turkey—Mesopotamia. **Willcocks.**
The Irrigation of Mesopotamia. By Sir William Willcocks. Cairo, 1905. Size 10½ × 7, pp. 154. *Maps.* *Presented by the Author.*

Turkey—Syria and Palestine. **Hanauer and Masterman.**
Cook's Handbook for Palestine and Syria. New edition, thoroughly revised by the Rev. J. E. Hanauer and Dr. E. G. Masterman. London: Cook & Sons, 1907. Size 7 × 4½, pp. viii. and 416. *Maps.* *Price 7s. 6d. net.* *Presented by the Publishers.*

AFRICA.

British Central Africa—Ethnology. **Werner.**
The Native of British Central Africa. By A. Werner. (The Native Races of the

British Empire.) London: A. Constable & Co., 1906. Size 9 × 5½, pp. xii. and 304. *Sketch-map and Illustrations. Price* 6*s. net. Presented by the Publishers.*

The first volume of this useful series was noticed in the April number.

Morocco. *La G., B.S.G. Paris* **14** (1906): 369–374. **Gentil.**

L'œuvre topographique du capitaine Larras au Maroc. Par Louis Gentil. *With Sketch-map.*

Nigeria. **[Egerton.]**

Southern Nigeria. Report for 1905. (Colonial Reports, Annual, No. 512, 1906.) Size 9½ × 6, pp. 64. *Price* 8*d.*

Réunion. *K.A.W. Amsterdam, G. Sect. Sc.* **8** (1905): 110–126. **Oudemans.**

Supplement to the account of the determination of the longitude of St. Denis (Island of Réunion), executed in 1874, containing also a general account of the transit of Venus. By Prof. J. A. C. Oudemans.

Rhodesia—Botany. *J. Linnean S., Botany* **37** (1906): 425–494. **Gibbs.**

A Contribution to the Botany of Southern Rhodesia. By Miss L. S. Gibbs. *With Illustrations.*

The illustrations explain the general characters, rather than the purely botanical features, of the vegetation.

Rhodesia—Language. **Schoeffer.**

A grammar of the Bemba language, as spoken in North-East Rhodesia. By Rev. Father Schoeffer. Edited by J. H. West Sheane; arranged by A. C. Madan. Oxford: Clarendon Press, 1907. Size 7 × 4½, pp. 72. *Price* 2*s.* 6*d. net. Presented by the Publishers.*

Sahara. *La G., B.S.G. Paris* **14** (1906): 317–341. **Cortier.**

De Tombuctou à Taodéni. Relation du raid accompli par la compagnie des méharistes du 2e Sénégalais commandée par le Capitaine Cauvin, 26 février—17 juin 1906. Par le Lieut. Cortier. *With Map and Plans.*

See note in the March number.

St. Helena. *J.R. Col. I.* **38** (1906): 38–49. **Melliss.**

St. Helena. By J. C. Melliss.

St. Helena. **Morris.**

Colonial Reports, Miscellaneous, No. 38. Reprint of a Report (written in 1884) upon the Present Position and Prospects of the Agricultural Resources of the Island of St. Helena. By D. Morris. London, 1906. Size 9½ × 6, pp. 36. *Map. Price* 3½*d.*

South Africa. *G.Z.* **12** (1906): 601–611. **Penck.**

Süd-Afrika und Sambesifälle. Von Albrecht Penck.

Some of Prof. Penck's conclusions, arrived at during his journey in South Africa with the British Association, were referred to in vol. **27**, p. 630.

Sudan. **Kumm.**

The Sudan. A short compendium of facts and figures about the land of darkness. By H. Karl W. Kumm. London: Marshall Bros., [1907]. Size 9 × 5¾, pp. xiv. and 224. *Maps and Illustrations. Price* 6*s.* 3*d. net. Presented by the Publishers.*

A concise account of the Sudan by a missionary who has made a special study of its literature, and possesses personal knowledge both of its eastern and western sections.

Transvaal—Geology. ——

Transvaal Mines Department. Report of the Geological Survey for the year 1905. Pretoria, 1905. Size 13 × 8½, pp. 114. *Maps, Illustrations, and Sections.*

Tunis. *Norske G.S. Aarbog.* **17** (1905–6): 65–96. **Reusch.**

Tunis. Af Dr. H. Reusch. *With Illustrations.*

Uganda—Botany. *J. Linnean S., Botany* **37** (1906): 495–544. **Stapf and Dawe.**

Plantæ Novæ Daweanæ in Uganda lectæ. By Otto Stapf. Notes on the Vegetation of Buddu and the Western and Nile Provinces of the Uganda Protectorate. By M. T. Dawe. *With Map and Illustrations.*

The general results of Mr. Dawe's journey were described in the *Journal* for September, 1906 (p. 291).

West Africa—Boundary. ———

Treaty Series, No. 5, 1907. Agreement between the United Kingdom and France relative to the frontier between the British and French possessions from the Gulf of Guinea to the Niger. October 19, 1906. London, 1907. Size 9½ × 6, pp. 14. *Maps. Price* 1*s.* 1*d.*

The line of frontier is described in detail.

POLAR REGIONS.

Antarctic. *La G., B.S.G. Paris* **14** (1906): 245–260. **Charcot.**

Exposé des travaux scientifiques de l'expédition antarctique française, 1903–1905. Par Jean Charcot. *With maps and Illustrations.*

Antarctic—Fauna. *T.R.S. Edinburgh* **41** (1904–05): 519–532. **Eliot.**

The Nudibranchiata of the Scottish National Antarctic Expedition. By Sir Charles Eliot. *With Illustrations.*

Antarctic—Fauna. **Rennie and others.**

P.R.S. Edinburgh **26** (1905–6): 437–446, 464–583.

"Scotia" collections. On *Echinorhynchus antarcticus*, n. sp., and its allies. By John Rennie. *With Plates* (pp. 437–446).

Nematodes of the Scottish National Antarctic Expedition, 1902–1904. By Dr. v. Linstow. *With Plates* (pp. 464–472).

Collembola from the South Orkney Islands. By George H. Carpenter. *With Plates* (pp. 473–483).

Arctic—Historical. **Hoare.**

Arctic Exploration. By J. Douglas Hoare. London: Methuen & Co., [1906]. Size 9 × 5½, pp. viii. and 314. *Maps and Illustrations. Price* 7*s.* 6*d. net.*

Deals mainly with the work of the nineteenth century, the early voyages being very briefly touched upon. A certain lack of proportion is sometimes noticeable. Thus hardly more than a page is devoted to the voyage of the *Vega*, while Franklin's land journeys, only in part concerned with the Arctic regions, are dealt with at length.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Limestone Reefs. *Quarterly J. Geol. S.* **62** (1906): 702–711. **Chapman and Mawson.**

On the importance of *Halimeda* as a Reef-forming Organism, with a description of the *Halimeda* Limestones of the New Hebrides. By Frederick Chapman and Douglas Mawson. *With Illustrations.*

Limnology—Temperatures. *Naturw. Wochenschrift.* **21** (1906): 705–709. **Risch.**

Die thermische Sprungsicht der Seen. Von C. Risch. *With Diagrams.*

Meteorology. ———

Kaiserliche Marine: Deutsche Seewarte. Tabellarische Reiseberichte nach den meteorologischen Schiffstagebüchern. 3. Band. Eingänge des Jahres 1905. Berlin, 1906. Size 10½ × 7½, pp. viii. and 192.

Meteorology—Atmosphere. **Legendre.**

B. Musée Oceanographie, Monaco, No. 84 (1906): pp. 8.

Le teneur en acide carbonique de l'air marin. Par R. Legendre. *With Illustration and Map.*

Meteorology—Aurora. **Arrhenius.**

Die Nordlichter in Island und Grönland. Von Svante Arrhenius. (Meddelanden från K. Vetenskapsakademiens Nobelinstitut, Band I., No. 6.) Upsala, etc., 1906. Size 9 × 6, pp. 28. *Illustrations and Diagram. Price* 75 *öre.*

Meteorology—Precipitation. **Marloth and Hann.**

Meteorologische Z. **23** (1906): 547–553.

Ueber die Wassermengen, welche Sträucher und Bäume aus treibendem Nebel und Wolken auffangen. Nach Dr. Marloth.

Besides describing the results of Dr. Marloth's experiments (*Journal*, vol. **24**, p. 96; vol. **28**, p. 76), Dr. Hann refers to earlier investigations on the same subject.

Meteorology—Temperature. *Monthly Weather Rev.* **34** (1906): 370–374. **Milham.**
Variation in temperature over a limited area. By Prof. Willis I. Milham. *With Diagrams.*

Mountain-building. *C.R.A. Sc., Paris* **143** (1906): 1268–1269. **Meunier.**
Sur d'anciennes expériences de M. Daubrée et de M. de Chancourtois relatives à l'imitation des chaînes de montagnes. Note de Stanislas Meunier.

Oceanography—Relief. **Ricchieri**
Terminologia Morfografica dei Fondi Oceanici. Considerazioni e proposte del Prof. Giuseppe Ricchieri. (Estratto dalla 'Rivista Geografica Italiana,' Anno xiii. Fasciculo viii. e ix.) Firenze, 1906. Size 9½ × 6, pp. 20. *Presented by the Author.*

Seismology. **Schütt.**
Die Hauptstation für Erdbebenforschung am Physikalischen Staatslaboratorium zu Hamburg. Von Dr. R. Schütt. (Sonderabdruck aus 'Die Erdbebenwarte,' 1905–06, Nr. 9 bis 12, V. Jahrgang.) Laibach, 1906. Size 9½ × 6½, pp. 6. *Illustrations. Presented by the Author.*

Seismology. *Sc. P.R. Dublin S.* **11** (1906): 107–110. **Gill.**
On a possible connection between the Eruption of Vesuvius and the Earthquake at San Francisco in April, 1906. By the Rev. H. V. Gill.
Noticed in the March number.

Seismology. *G. Ts., K. Danske G.S.* **18** (1905–06): 288–295. **Harboe.**
En sejsmologisk Oversigt. Af Oberstløjtnant E. G. Harboe. *With Map.*

Volcances. *J. Bombay Br., R. Asiatic S.* **22** (1906): 135–142. **Modi.**
Maçoodi on Vulcanoes. By Jivanji Jamshedji Modi.

Volcanoes. *Mem. American A.* **13** (1906): 149–178. **Pickering.**
Lunar and Hawaiian physical features compared. By William H. Pickering. *With Illustrations and Sections.*

BIOGRAPHY.

Bonpland. **Hamy.**
Aimé Bonpland: médecin et naturaliste; explorateur de l'Amérique du Sud. Par le Dr. E. T. Hamy. Paris: E. Guilmoto, [1906]. Size 9 × 5½, pp. xcviii. and 300. *Map and Portrait. Price* 7.50 *fr.*

An introductory section presents a biography of the traveller, based on original documents, a selection from which is printed in the body of the work.

Burchell. **Poulton.**
William John Burchell. By Edward B. Poulton. (Reprinted from the *Report of the British and South African Associations*, 1905.) London, 1907. Size 9 × 6, pp. 56. *Portrait. Presented by the Author.*

Sheds fresh light on Burchell's travels in South Africa and Brazil early in the nineteenth century.

GENERAL.

Educational. *B.G.S. Philadelphia* **5** (1907): 30–36. **Dryer.**
The Oxford School of Geography. By Charles Redway Dryer.

Geography—Dictionary. **Demangeon.**
Dictionnaire-manuel illustré de géographie. Nomenclature des noms de lieux, des voyageurs, explorateurs et géographes; définitions de physique terrestre, de météorologie, de morphologie, de géographie botanique, zoologique et humaine, de géographie industrielle, commerciale, maritime et politique; définitions de cartographie. Par Albert Demangeon. Paris: A. Colin, 1907. Size 7½ × 4½, pp. viii. and 860. *Maps, Illustrations, and Diagrams. Price* 6 *fr. Presented by the Publisher.*

A most useful work, the want of which must have been frequently felt by students, though the labour involved in its compilation has no doubt deterred many from undertaking it.

German Colonies—Bibliography. **Reimer.**

Dietrich Reimer's Mitteilungen über koloniale Bücher u. Karten. Ratgeber für deutsche Ansiedler, Pflanzer, Kolonialbeamte, Offiziere der Schutztruppen, Forschungsreisende, Bibliotheken und Kolonialfreunde. Heft 1. Januar 1907. Berlin: D. Reimer, 1907. Size 8½ × 6, pp. 82. *Index-maps and Diagrams. Price 30 pf. Presented by the Publisher.*

Irrigation. *Z. Ges. E., Berlin* (1906): 540–648, 674–685. **Hahn.**

Ueber künstliche Bewässerung, besonders den Ackerbau mit künstliche Bewässerung nach der Theorie Ferdinand von Richthofens. Von Dr. Eduard Hahn.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

British Isles. **Woodward.**

Stanford's Geological Atlas of Great Britain and Ireland, with plates of characteristic fossils, preceded by descriptions of the geological structure of Great Britain and Ireland and their counties, and of the features observable along the principal lines of railway. By Horace B. Woodward, F.R.S., F.G.S. Second edition. London: Edward Stanford, 1907. *Price 12s. 6d. net. Presented by the Publisher.*

In the second edition of this interesting and instructive little atlas, the scope of the work has been enlarged by the addition of a sketch of the geological features of Ireland, which is illustrated by a geological map of the country and three illustrations borrowed from Prof. E. Hull's 'Physical Geology and Geography of Ireland.' The text as given in the first edition has been but slightly altered, but the maps have been revised.

England and Wales. **Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from May 1 to 31, 1907.

2 miles to 1 inch.

Printed in colours, folded in cover or flat in sheets, Birmingham and District, special map of. *Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d. each.*

1 inch—(third edition):—

In outline, sheets (81 and 82), 89, 91, 170, 206, 248, 295, 312 1*s. each* (engraved). With hills in brown or black, 72, 171, 172, 186, 246, (261, and 262), 296 (357 and 360). 1*s. each* (engraved).

6-inch—County Maps (first revision):—

Carmarthenshire, 9 N.W., 13 S.E., 14 S.E., 16 N.W., N.E., S.W., S.E., 17 N.W., S.W., S.E., 18 N.W., N.E., 22 N.E., S.W., S.E., 23 N.W., 25 N.W., 49 S.W., 55 N.E. **Cornwall,** 1 (S.W. and S.E.), 4 N.W., 6 N.W., S.W., 8 N.E., 16 N.E., 23 N.W., 29 N.W., 30 N.W. **Devonshire,** 42 S.W., 49 S.E., 61 N.W., 73 N.W., S.E., 74 N.W., S.W., 85 N.E., 86 N.W., 96 N.E., 98 S.W., 121 S.W., 125 S.W. **Lincolnshire,** 34 N.W., S.E., 38 N.W., N.E., S.W., 39 N.W., 47 N.W., 48 N.E., 49 N.W., (49 S.E., and 49*a* S.W.), 58 S.W. **Norfolk,** 39 S.E., 40 N.W., S.E., 52 S.E., 87 S.E. **Pembrokeshire,** 12 N.E. **Yorkshire** (First Revision of 1891 Survey), 263 N.W., 273 N.E., 274 N.W., 278 N.W. 1*s. each.*

25-inch—County Maps (first revision):—

Carmarthenshire, XXVIII. 7, 8, 14, 15; XXXVI. 3, 6, 7; LIX. 2. 3*s. each.* XXVIII. 6. 1*s.* 6*d.* **Cornwall,** XVIII. 16; XX. 2, 11, 15; XXV. 7, 10; XXXII. 13, 14, 15, 16; XXXIII. 13, 14, 15, 16; XXXIV. 1, 6, 13, 14, 15, 16; XXXIX. 3, 6, 9, 12, 14, 15, 16; XL. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15; XLI. 1, 2, 3, 4; XLII. 1, 2, 3, 6, 8, 10; XLIII. 1, 5, 9, 13; XLVIII. 2, 3, 4, 6, 7, 8; XLIX. 1, 2, 3, 5, 6, 7, 9, 11; LI. 2, 3, 6, 8, 11, 12, (15 and 16); LII. 1, 5, 9. **Lancashire** (First Revision of 1891 Survey), CIX. 4, 8, 12, 16; CX. 9; CXI. 5, 6, 7, 8, 10, 12; CXII. 5; CXIII. 11, 12, 16; CXIV. 9, 11, 13, 16; CXV. 6, 7, 9, 10, 13, (14 without areas); CXVI. 4; CXVIII. 2, 3, 4, 7. 3*s. each.* CX. 7, 8; CXI. 14; CXII. 6, 9. 1*s.* 6*d. each.* **Lincolnshire** (First Revision), XVIII. 10, 16; XXX. 4; XXXI. 16; XXXII. 13; LXI. 14, 15; LXX. 1, 2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 15, 16. **Pembrokeshire,** VI. 15, 16; XI. 4, 5, 6, 7, 9, 13, 14; XVIII.

5, 6, 7. **Yorkshire** (First Revision of 1891 Survey), CCXXII. 9, 13; CCXXXVII. 13; CCXLVI. 12, 15; CCXLVII. 1, 8, 12, 13, 15, 16; CCXLIX. 1, 2. **Kent** (Second Revision), XXIV. 8, 12; XXV. (2 and 6), 4, 5, (6 and 2), 7, 9, 10, 11, 12, 14, 15, 16; XXVI. 1, (2 and 6), 5, (6 and 2), 9, 10, 13, 14; XXXV. 6, 7, 8, 12; XXXVI. 5, 9; XXXVII. 2, 3, 6, 7, 10, 11; XXXVIII. 1, 5; XLVI. 14, 15, 16; XLVII. 13; LVI. 4; LVII. 1; * LXXIV. 4; LXXV. 1, 3; * LXVII. 6, 7, 10, 11, 13, 14, 15; LXXIV. 3, 4, 6, 7, 8, 10, 11, 12, 14, 15, 16; LXXXVI. 1, 2, 4, 5, 7. *3s. each.*

(*E. Stanford, London Agent.*)

France. **Ministre de l'Intérieur, Paris.**

Carte de la France dressée par ordre du Ministre de l'Intérieur. Scale 1 : 100,000 or 1 inch to 1·3 stat. mile. Sheets: xvii.-28, St. Cernin (Cantal); xxiii.-29, Die; xxv.-25, Sallanches; xxv.-31, Barcelonnette. New editions. Paris: Ministère de l'Intérieur, Service Vicinal, 1907. *Price* 0.80 *fr. each sheet.*

Holland. **De Geest.**

Kaart van Nederland met de Spoor-, Tram-, Straat-, en Kunstwegen. Door E. de Geest. Met Alfabetisch Register der Plaatsnamen. Scale 1 : 400,000 or 1 inch to 6·3 stat. miles. Amsterdam: Seyffardt's Boekhandel, 1907. *Price f.* 1.25.

A useful general map, showing means of communication by rail and water, and including the Netherlands, Belgium north of Brussels, and part of western Prussia. There is an alphabetical index to place-names accompanying the map.

London. **Bartholomew.**

Plan of London. By John Bartholomew, F.R.G.S. Scale 3·25 inches to 1 stat. mile. 4 Sections. Edinburgh: John Bartholomew & Co., [1907]. *Price 2s. net each, mounted on cloth. Presented by the Publisher.*

A revised edition of a clear and useful plan of London and environs, printed in colours. Sheets are in outline, only the important buildings being shaded.

Switzerland. **Abteilung für Landestopographie, Bern.**

Topographischer Atlas der Schweiz (Siegfried Atlas). Scale 1 : 25,000 or 2·5 inches to 1 stat. mile. Sheets: 7, Therwil; 13, Schleitheim; 114, Biaufond; 115, Les Bois; 135, Twann; 230, Wald; 231, Wattwil; 232, Schmerikon; 246bis, Schübelbach; 247, Schänis; 250bis, Speer, 1906; 255, Buchs; 283, Ste. Croix; 290, Lignerolle; 292, Orbe; 331, Fribourg; 352, Wattenwil; 353, Thun. New editions. Bern: Abteilung für Landestopographie, 1906. *Price* 1 *fr. each sheet.*

ASIA.

Asia. **Service Géographique de l'Armée, Paris.**

Carte de l'Asie. Scale 1 : 100,000 or 1 inch to 1·58 stat. miles. Sheets: Nour-Ata, Tachkent. Paris: Service Geographique de l'Armée, 1904. *Price* 1.25 *fr. each sheet.*

These are two adjacent sheets, and together include the region between 40° to 44° N. lat., and extend in an east and west direction from the Oxus to about 90 miles east of Andijan, the terminus of the Trans-Caspian railway.

China. **K. Preussische Landesaufnahme.**

Karte von Ost-China. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. Sheets: Kwëi lin fu; Tschung King fu. Berlin: K. Preussische Landesaufnahme, 1907.

Persia. **Stahl.**

Routenkarte von Nordwest-Persien. Nach eigenen Aufnahmen von A. F. Stahl. Scale 1 : 840,000 or 1 inch to 13·2 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1907, Tafel 10. Justus Perthes, 1907. *Presented by the Publisher.*

The route shown on this map extends from the Araxes on the west, through Tabriz and Kazvin to beyond Mount Damowend on the east, and from Resht on the Caspian as far south as Hamadan. An account of the author's journeys, accompanied by this map, is given in *Petermanns Mitteilungen* for last month.

AFRICA.

Alexandria. **Survey Department, Cairo.**

Provisional Map of Alexandria and environs. Scale 1 : 50,000 or 1·3 inch to a stat. mile. 2 Sheets. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

Egypt. **Survey Department, Cairo.**

Map of Egypt. Scale 1:50,000 or 1·3 inch to a stat. mile. Sheets: N.E. I.-II., III.-III.; S.E. XIV.-II., XV.-I., XV.-II., XVI.-II., XVI.-III., XVII.-II., XVII.-III., XVII.-IV., XVIII.-III., XVIII.-IV., XIX.-III., XIX.-IV., XIX.-V., XXX.-VIII. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

Northern Nigeria. **Marquardsen.**

Karte des Gebietes zwischen Ibi und Gola. Von H. Marquardsen. Scale 1:750,000 or 1 inch to 18·9 stat. miles. *Petermanns Mitteilungen*, Jahngang 1907, Tafel 9. Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

A route followed in March, 1903, along the southern bank of the Benue from Ibi to Yola. No astronomical observations were taken, and the traverse is adjusted to positions previously determined. A note accompanying the map is given in the May number of *Petermanns Mitteilungen*.

Tunis. **Service Géographique de l'Armée, Paris.**

Carte de la Tunisie. Scale 1:100,000 or 1 inch to 1·3 stat. mile. Sheet LXIX., La Skhirra. Paris: Service Géographique de l'Armée, 1907. *Price* 1.50 *fr. each sheet.*

AMERICA.

Canada. **Department of Militia and Defence, Ottawa.**

Topographic map of Canada. Scale 1: 63,360 or 1 inch to a stat. mile. Ontario. Sheets: 4, Grimsby; 7, Fort Erie. Ottawa: Intelligence Branch, Department of Militia and Defence. London: Topographical Section, General Staff, War Office, 1907. *Presented by the Director of Military Operations.*

The Grimsby sheet extends from 43° to 43° 15′ N. lat., and from 79° 30′ to 80° W. long., and includes the southern portion of Hamilton and Grimsby on Lake Ontario. The Fort Erie sheet is occupied by the city of Buffalo and its immediate surroundings. Both are carefully drawn and printed in colours, as described in the notice of the first sheets to be issued, which appeared in the April number of the *Geographical Journal*.

Canada. **White.**

Atlas of Canada. Prepared under the direction of James White, F.R.G.S., Geographer, Department of the Interior, Canada. Ottawa: Department of the Interior, 1906. *Presented by James White, Esq.*

For emigrants and others desirous of obtaining reliable and up-to-date information concerning the resources, development, and physical geography of the Dominion of Canada, this is a most important publication. It furnishes graphically, by means of an excellent series of maps, diagrams, and statistical tables, the latest information on these subjects from the most authentic sources. There are, first of all, thirteen pages of statistical tables, giving areas and population of various provinces and cities, towns, and villages, from the census returns of 1901; then follows a series of forty-six coloured maps, illustrative of the relief, geology, mineral resources, forests, telegraphs and telephones, railways, canals, lighthouses, sailing routes, temperature, density of population, and other subjects. After these come forty-three plates of diagrams, giving at a glance a very clear idea of the exports, imports, distribution of the population, vital statistics, religions, agricultural and mineral development, fisheries, and many other matters connected with the material and commercial progress of the Dominion. Earlier editions of some of the maps have previously appeared as separate publications, but the greater number of them have been specially prepared for this atlas.

Chile. **Steffen.**

Das Haupterschütterungs-Gebiet des Mittelchilenischen Erdbebens vom 16. August 1906. Von H. Steffen. Scale 1:500,000 or 1 inch to 7·8 stat. miles. *Petermanns Mitteilungen*, Jahgang 1907, Tafel 11. Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

GENERAL.

World. **Harmsworth.**

Harmsworth Atlas and Gazetteer. 500 maps and diagrams, and 105,000 references. Parts 15 and 16. London: The Amalgamated Press, Ltd., 1905. *Price 7d. each part.*

These parts contain the following maps:—Part 15. Nos.: 19–20, The British Isles (industries and communications); 119, Southern India and Ceylon; 120, the Malay

Peninsula; 171–172, North-central United States. Part 16, Nos.: 7–8, The New World; 49–50, Eastern France; 81–82, Northern Italy.

World. **Johnston.**

The Handy Royal Atlas of Modern Geography, exhibiting the present condition of geographical discovery and research in the several countries, empires, and states of the world. By the late Alexander Keith Johnston, with additions and corrections to the present date by G. H. Johnston. Edinburgh and London: W. & A. K. Johnston, 1907. *Price* £2 12*s.* 6*d.* *Presented by the Publisher.*

The maps in this well-known and useful atlas have been, on the whole, fairly well revised as regards alterations to boundaries, new railways, etc.; but on some of the maps the physical features are seriously behind the times, as will be seen from an inspection of No. 39, Abyssinia, which is much out of date. A good and carefully executed map of the Arctic Regions is given, and an entirely new map of Japan has been added; but it is remarkable, considering the recent activity and important discoveries made in the neighbourhood of the south pole, that no map is given of this region.

World. **St. Martin and Schrader.**

Atlas Universel de Géographie construit d'après les sources originales et les documents plus récents, cartes, voyages, mémoires, travaux, géodésiques, etc., avec un texte analytique. Ouvrage commencé par M. Vivien de Saint Martin et continué par Fr. Schader. Sheet No. 63, Algérie, Tunisie. Paris: Hachette et Cie., 1907. *Presented by the Publisher.*

This map is the work of Lieut.-Colonel F. Prudent, who is a recognized authority on the cartography of Algeria and Tunis, and a good topographer. It includes the whole of Algeria and Tunis, and extends as far south as the 27th parallel of north latitude. A sheet of letterpress accompanies the map, giving a list of surveys and maps utilized in the compilation, together with other information. As a specimen of copperplate engraving, this map is excellent, but the fact that the hill-work is printed in black gives it a somewhat dull and heavy appearance, besides rendering it difficult to read the names in places. It would be a great improvement if the hill-work could be printed in brown in another edition.

World. **Stieler.**

Neunten, von Grund aus neubearbeiteten und neugestochenen Auflage von Stielers Hand-Atlas, 100 Karten auf 200 Seiten mit 162 Nebenkarten in Kupferstich und einem alphabetischen Verzeichnis aller im Atlas verkommenden Namen (ungefähr 240,000 Namen enthaltend) herausgegeben von Justus Perthes' Geographischer Anstalt in Gotha. Lieferung 53 and 54. Gotha: Justus Perthes, 1907. *Price* 60 *pf. each part.*

These parts contain the following maps: Parts 53–54, Nos. 22, Italien, Bl. 1; 75, Afrika, Bl. 7; 81, Südsee-Inseln.

Charts.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during April, 1907. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.	
3604 m =	0·7	Baltic sea, Sweden, east coast:—Stockholm Skärgård, southern portion. 3*s.*
3640 m =	3·55	France, west coast:—Anse de Benodet. 3*s.*
3654 m =	3·6	North American lakes, Lake Erie:—Sandusky bay, eastern portion. 2*s.*
3627 m =	var.	South America, Magellan strait. Anchorages in Martinez and Baker channels:—Port Merino Jarpa, Laguera cove, Port Valdes, Port Alvarez, Port Cueri Cueri, Port Valenzuela, Port Brown, Dewet cove, Port Tres Meses, Port Contreras, river Huemules, Port Quellehue, Port Francisco. 3*s.*
3634 m =	var.	Alaska. Plans in Prince of Wales island:—McKenzie inlet, Hollis anchorage, Cordova bay and Hetta inlet, Dolomi anchorage and Port Johnson, North arm of Moira sound, Lyman anchorage. 3*s.*
3637 m =	var.	Alaska. Plans in the neighbourhood of Chatham strait:—Red Bluff bay, Hoggatt bay, Herring bay and Chapin bay, Gut bay, Surprise harbour and Murder cove. 3*s.*

No.	Inches.	
3653 m	= 2·7	Alaska:—Whitewater and Chaik bays. 2*s*.
3655 m	= 0·6	Plans in Alaska:—Resurrection bay. 2*s*.
593 m	= 0·06	Alaska, Yukon river to point Barrow, including Bering strait. Plans:—Anchorage of Chamisso, Port Clarence and Grantley harbour. 3*s*.
3648 m	= 0·48 2·96	Africa, west coast:—Junk river to Cestos bay. Plan:—Grand Bassa. 3*s*.
1257 m	= 0·31	Korea:—Approaches to Ping Yang inlet and Yalu kiang, Choppeki point to Amunyoku kang (Yalu kiang). 3*s*.
3642 m	= 0·97	Korea:—A San anchorage and approaches. 2*s*.
3631 m	= 5·9	Japan, Kiusiu, west coast:—Yanagino seto and approaches. 2*s*.
3639 m	= var.	Japan. Plans in the north part of Honshu (Nipon):—Funakoshi wan, same anchorage, Fuku ura, Nezugaseki ko, Kuji wan. 2*s*.
3641 m	= 0·99	Australia, south coast:—Nepean bay. 2*s*.

New Plans and Plans added.

No.	Inches.	
472 m	= 2·9	Harbours and anchorages on the coast of Haïti or San Domingo. Plan added:—Port Jackson. 3*s*.
2406 m	= 1·3	Ports in San Domingo. Plan added:—Port Rincon. 2*s*.
2194 m	= 2·9 0·72 7·30	Sketch plan of anchorages in the eastern part of the Celebes. New plans:—Parigi road, Muton road. Plan added:—Labua sore. 2*s*.
2718 m	= 2·9	Anchorages on the east coast of the Celebes. New plans:—Una Una road, Togian bay, Pagimana road. 2*s*.

Charts Cancelled.

No.	Cancelled by	No.
593 Alaska:—Point Rodney to Point Barrow. Plans:—Chamisso anchorage, Port Clarence and Grantley harbour.	New chart. Yukon river to Point Barrow, including Bering strait. Plans:—Anchorage of Chamisso, Port Clarence, and Grantley harbour	593
1364 Africa, west coast:—Cape Mesurado to Baffu bay. Plan of Edina and Grand Bassa on this sheet.	Plan of Grand Bassa on chart	3648
1257 Korea. Approaches to Ping Yang inlet:—Peng Yong do to Yalu kiang.	New chart. Approaches to Ping Yang inlet, Choppeki point to Amunyoku kang (Yalu kiang)	1257

Charts that have received Important Corrections.

No. 109, England, east coast:—Entrance to the river Humber. 2184, Ireland, south-west coast, including Crookhaven. 1804, France:—Cape St. Sebastian to Cette. 2755, United States, east coast:—Long island sound, Sheet II. 761, West Indies, India islands, and Caribbean sea, Sheet I. 762, West Indies, India islands, and Caribbean sea, Sheet II. 2088, Africa, south coast:—Umtavuna river to Tugela river. 2137, Gaspar strait. 2636, Strait of Makassar, north part. 1261, Cochin China:—Saigon river to Kam ranh bay. 1459, China, south coast:—Hong Kong harbour. 2409, West coast of Formosa and Pescadores channel. 809, Tasmania:—Frederick Henry and Norfolk bays. 2766, North-east coast of New Guinea. 764, South-West Pacific:—New Hanover, New Ireland, and New Britain. 2532, New Zealand, Sheet IX.:—Banks peninsula to Otago.

(*J. D. Potter, Agent.*)

Indian Ocean and Red Sea. **Meteorological Office.**

Monthly meteorological chart of the Indian Ocean north of 15° S. lat. and Red sea, June, 1907. London: Meteorological Office, 1907. *Price* 6*d. each. Presented by the Meteorological Office.*

North Atlantic and Mediterranean. **Meteorological Office.**

Monthly meteorological chart of the North Atlantic and Mediterranean, June, 1907. London: Meteorological Office, 1907. *Price* 6*d. each. Presented by the Meteorological Office.*

North Atlantic. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic Ocean, May, 1907. Washington: U.S. Hydrographic Office, 1907. *Presented by the U.S. Hydrographic Office.*

North Pacific. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, June, 1907. Washington: U.S. Hydrographic Office, 1907. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Dutch Guiana. **Klein.**

Forty photographs of Dutch Guiana, taken by Eugen Klein, Photographer, Paramaribo. *Presented by C. W. A. Buma, Esq.*

From an ethnographical point of view, these photographs are of special interest, as the types of natives are remarkably good and well selected. Mr. Buma travelled some distance into the interior of Dutch Guiana last year, and on his return recently was good enough to add this set to our collection.

(1-6) Carib Indians, Boven Para; (7) Carib Indians hunting, Coropina creek, Boven Para; (8) Carib Indian woman making mats; (9) Carib Indian camp, Boven Para; (10) Carib Indian women grinding cassava meal; (11) Carib Indian women pounding cassava meal, Cottica; (12) Carib Indians, Galibi village, near Ablina; (13) Indian village, Boven Para; (14 and 15) Arawak Indians, Boven Para; (16) Europeans at a bush negro camp, Cottica; (17) Bush negroes in their corial, Boven Cottica; (18) Bush negroes, Wanhati, Cottica; (19) Bush negroes in the Saramacca; (20) Bush negroes with their corials at Cabende station, Boven Saramacca; (21) Bush negro chief with his retinue; (22) Indian village in the Cottica; (23) Showing children of the different races who attend the convent school, Paramaribo; (24) Bush negro governor.

New Zealand. **Ross.**

Thirty-one photographs of the New Zealand Alps, taken by Malcolm Ross, Esq. *Presented by G. E. Tolhurst, Esq.*

These photographs vary in size and excellence, but some are exceptionally good, and together they form an interesting and typical series illustrative of the peaks, glaciers, and mountaineering in the New Zealand Alps.

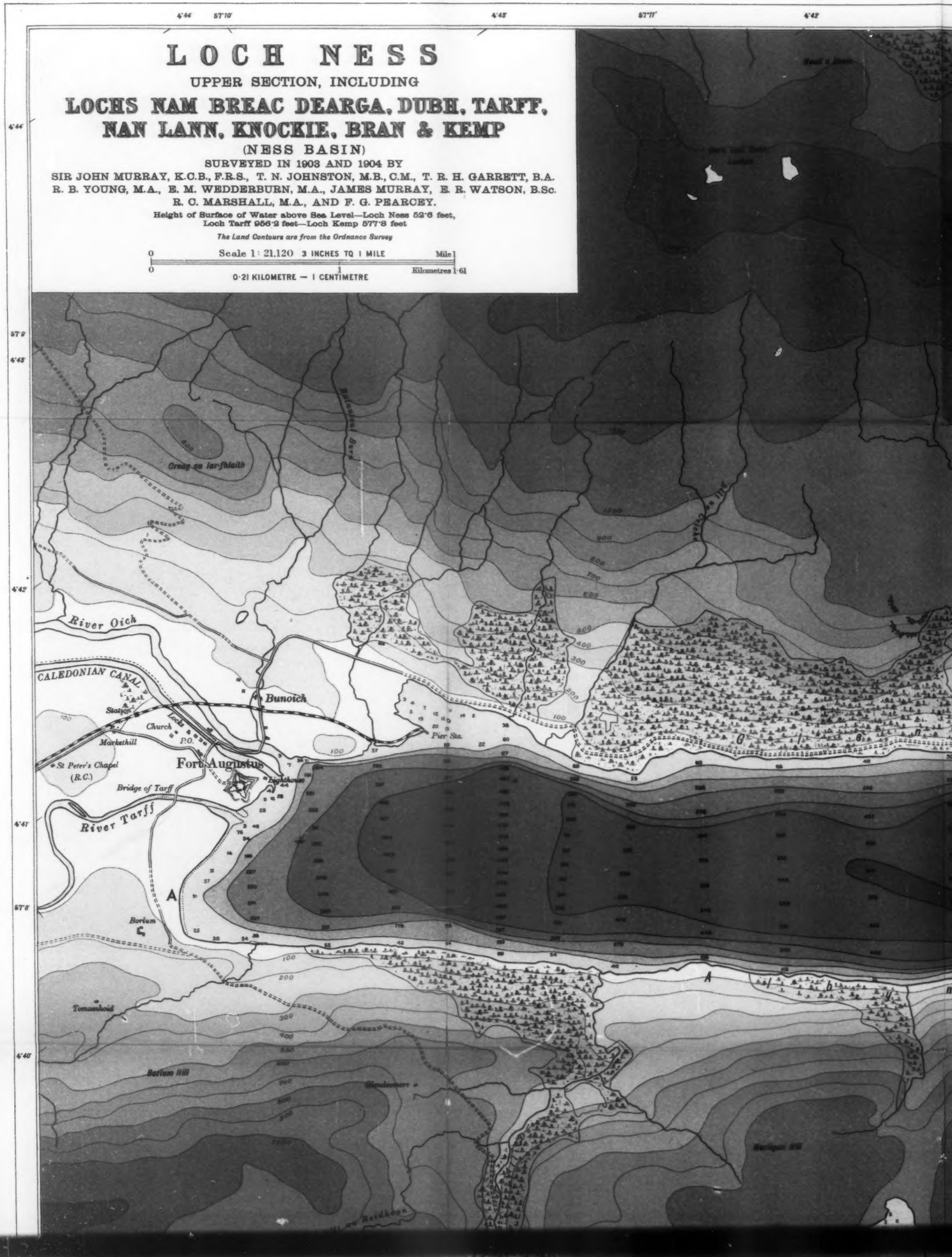
(1) Mount Ruapehu from the eastern side; (2) Looking at north peak of Ruapehu; (3) The old crater and glacier on the summit of Mount Ruapehu; (4) Mount Cook; (5) Looking back at Mount Sefton from the slopes of Mount Sealy; (6) Crossing the Hooker river in a "cage;" (7) The Hermitage, Mount Cook accommodation house; (8) Deep crevasse on the upper Tasman; (9) Ice-cliffs on the lower Tasman; (10) The Ball glacier, showing the formation of lateral moraine; (11) The Hooker river and glaciers of the Footstool, Mount Sefton; (12) The bivouac for the ascent of Mount Cook; (13) Mount Tasman, from 10,000 feet on Mount Cook; (14) Peaks of Liebig range; (15) Mount Cook range from the slopes of Mount Malte Brun range; (16) Mount Elie de Beaumont; (17) Alpine flora, Mount Cook region; (18) View looking south-west from the summit of Mount Sealy; (19) The upper precipices of Mount Sealy; (20) Fitzgerald's cairn on summit of Mount Sealy; (21) Mount Malte Brun; (22) Panorama of main range from Ball glacier; (23) Panorama showing some peaks on Malte Brun range; (24) The Mount Cook bivouac; (25) Arrival at the Mount Cook bivouac, on the first crossing of the mountain, 1906; (26) Actual summit of Mount Cook; (27) Broken ice on upper Tasman glacier; (28) Mount Sefton from Mount Sealy slopes; (29) Mount Cook from Sealy range; (30) On the Sealy range above the Hermitage; (31) Looking back at Mount Cook from the Tasman near Mount Malte Brun.

Siam. **Jardine.**

Three photographs of a Siamese native woman suckling a baby elephant, taken by Jardine, photographer, Cawnpore. *Presented by Lieut.-Colonel A. Gleadows Newcomen.*

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

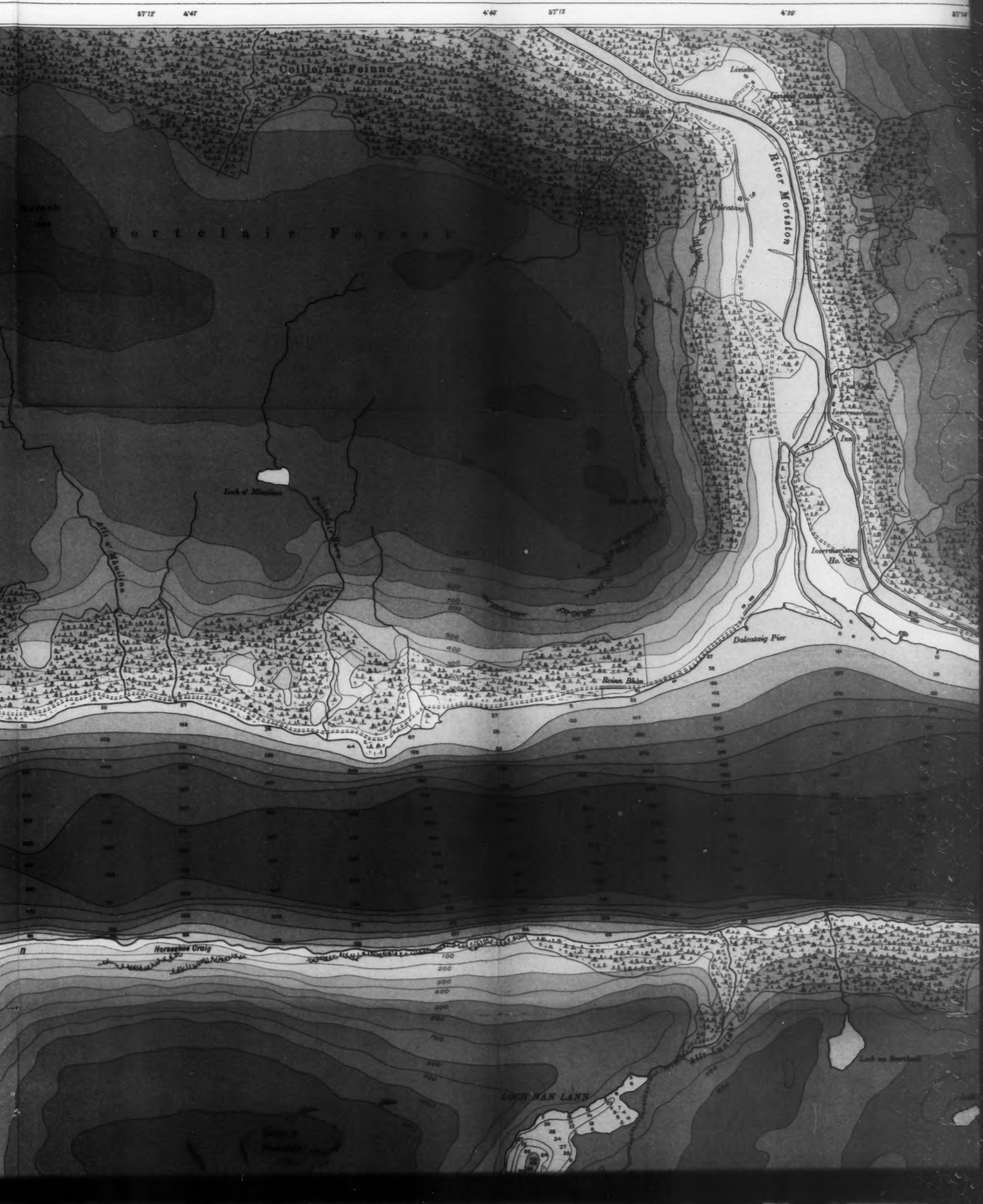
PLATE I

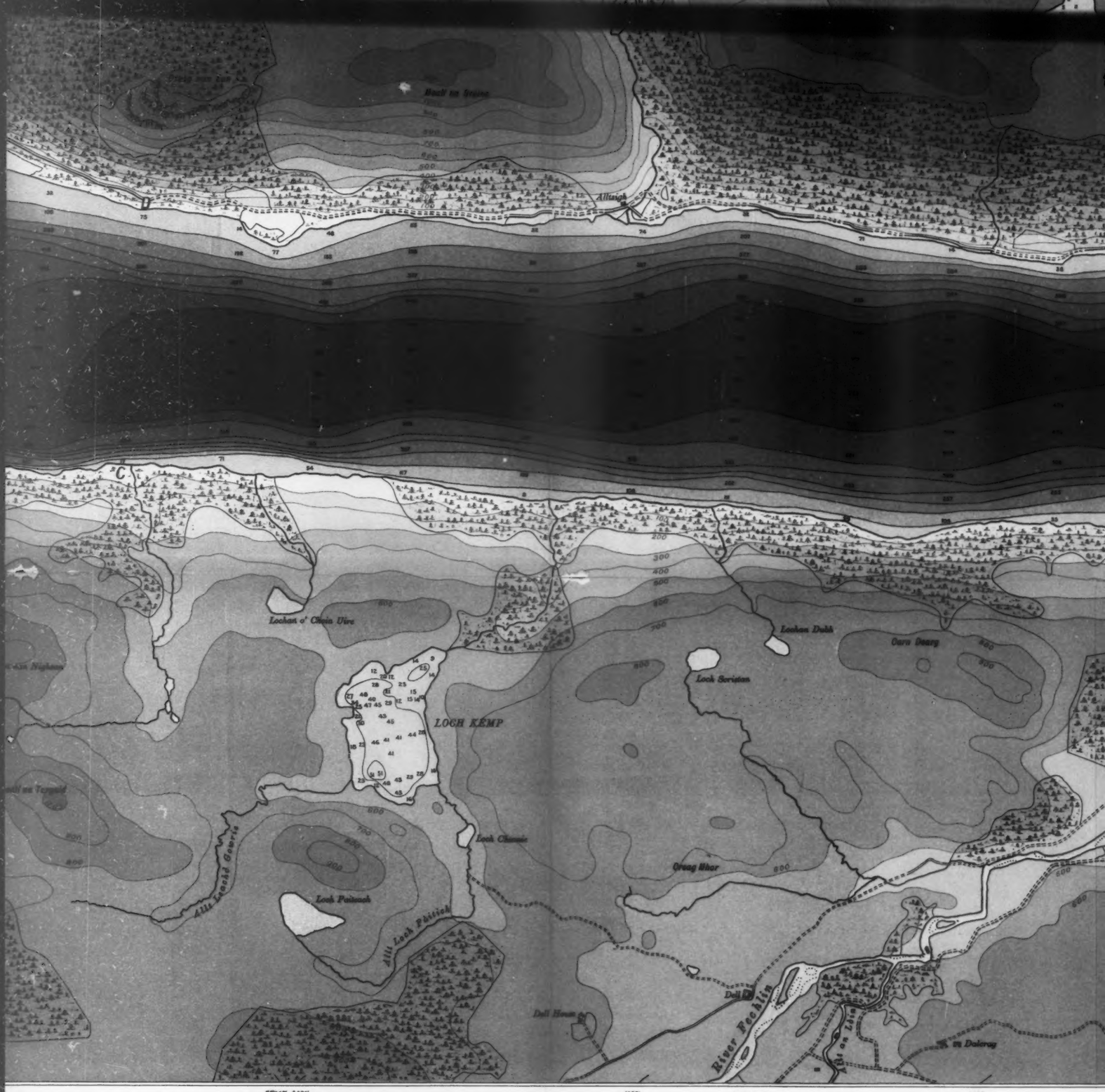

4°44'
57°10'
4°43'
57°11'
4°42'
57°9'
4°43'
4°42'
4°41'
57°8'
4°40'
LOCH NESS
UPPER SECTION, INCLUDING
LOCHS NAM BREAC DEARGA, DUBH, TARFF, NAN LANN, KNOCKIE, BRAN & KEMP
(NESS BASIN)
SURVEYED IN 1903 AND 1904 BY
SIR JOHN MURRAY, K.C.B., F.R.S., T. N. JOHNSTON, M.B., C.M., T. R. H. GARRETT, B.A.
R. B. YOUNG, M.A., E. M. WEDDERBURN, M.A., JAMES MURRAY, E. R. WATSON, B.Sc.
R. C. MARSHALL, M.A., AND F. G. PEARCEY.
Height of Surface of Water above Sea Level—Loch Ness 52·6 feet,
Loch Tarff 956·2 feet—Loch Kemp 577·8 feet
The Land Contours are from the Ordnance Survey
Scale 1 : 21,120 3 INCHES TO 1 MILE
Mile 1
Kilometres 1·61
0·21 KILOMETRE — 1 CENTIMETRE
Creag an Iar-fhlaith
River Oich
CALEDONIAN CANAL
Station
Locks
Church
P.O.
Bunoich
Pier Sta.
Markethill
St Peter's Chapel
(R.C.)
Fort Augustus
Lighthouse
Bridge of Tarff
River Tarff
Borlum
Tomanahoid
Borlum Hill
Reidhaon

BATHYMETRICAL SURVEY OF THE FRESH

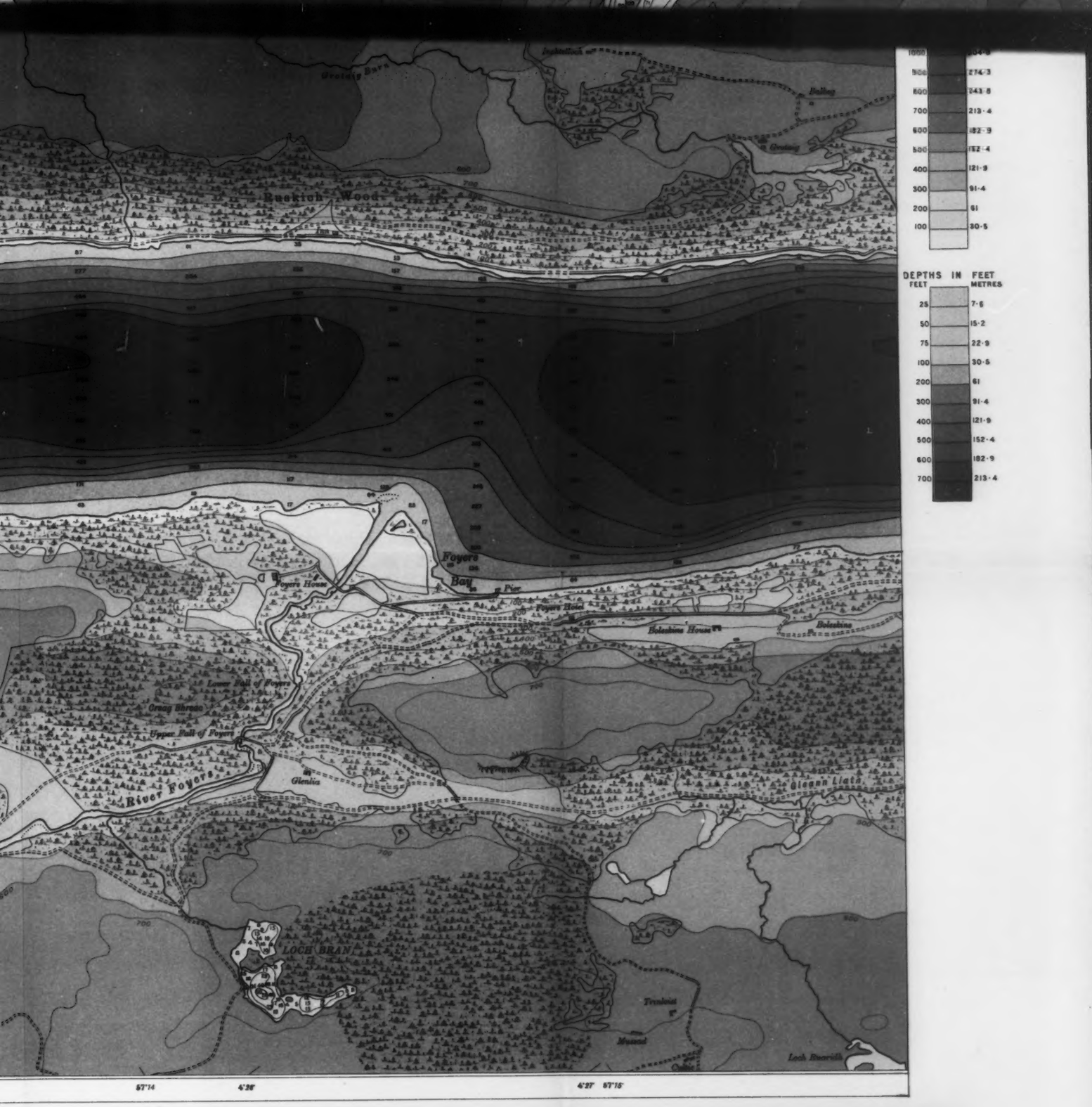
UNDER THE DIRECTION OF

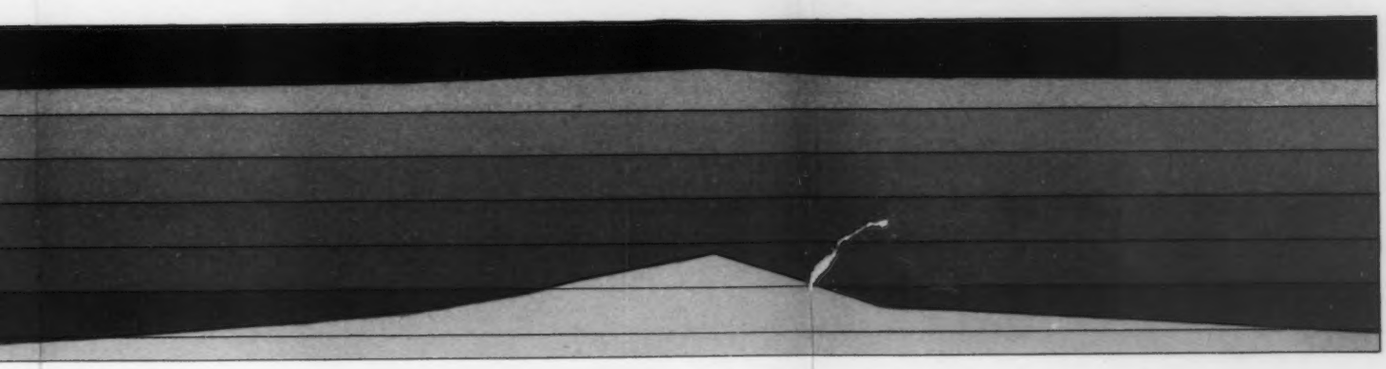
SIR JOHN MURRAY, K.C.B., F.R.S., D.Sc., AND LA





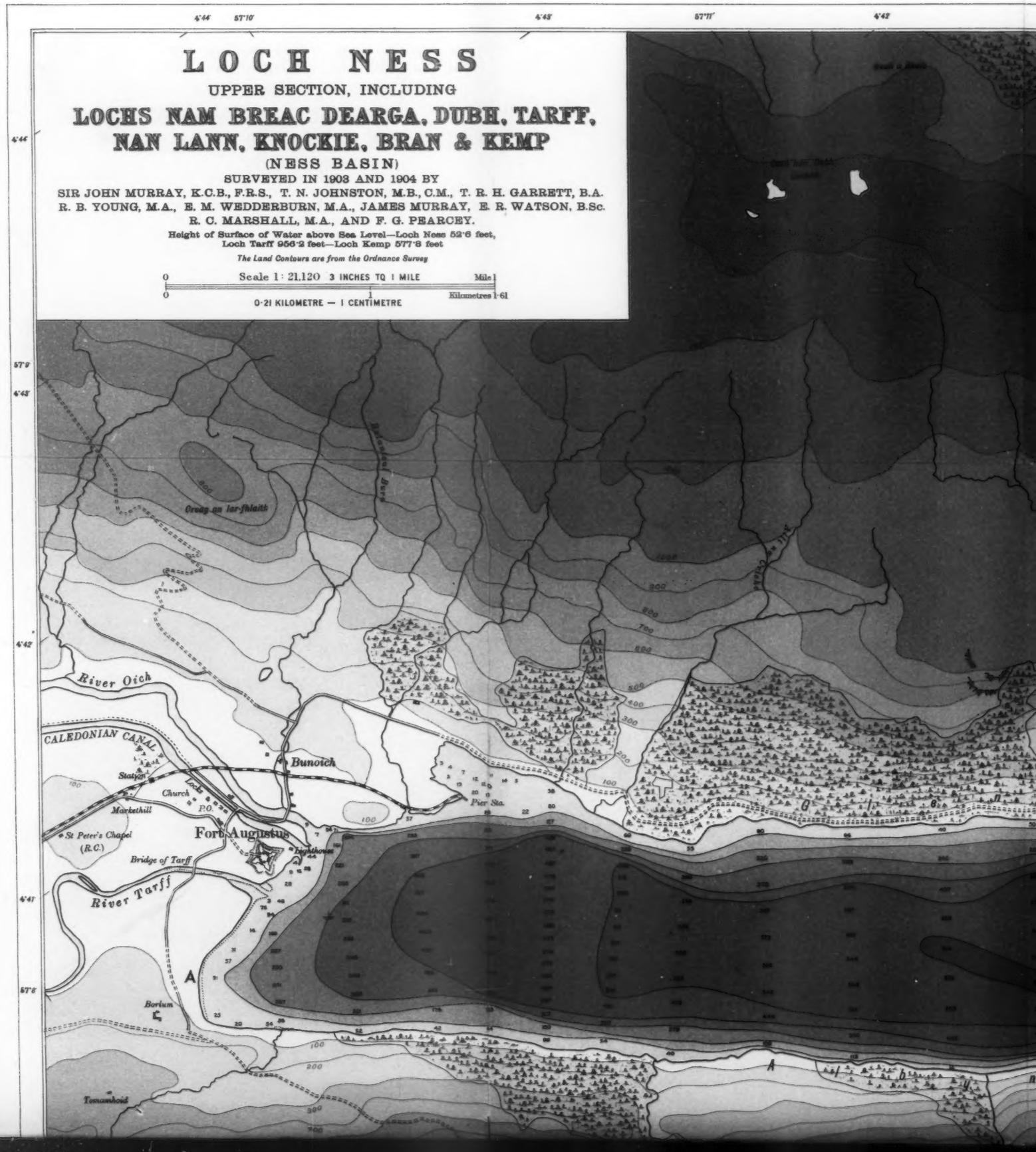
OF MAXIMUM DEPTH





J.G.Bartholomew

PLATE I


4°44'
57°10'
4°43'
57°11'
4°42'
LOCH NESS
UPPER SECTION, INCLUDING
LOCHS NAM BREAC DEARGA, DUBH, TARFF, NAN LANN, KNOCKIE, BRAN & KEMP
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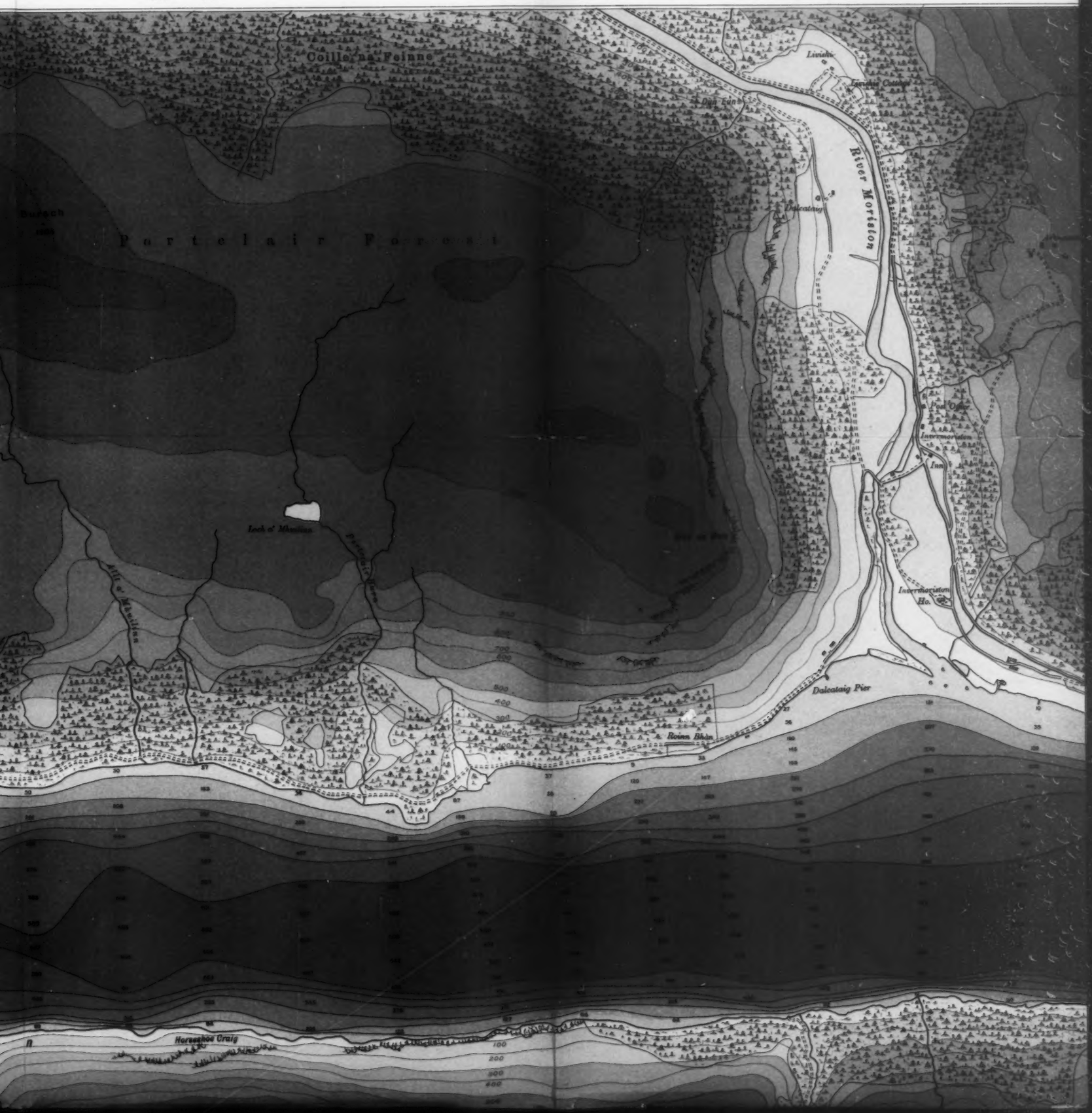
Miles
Kilometres 1·61
0·21 KILOMETRE — 1 CENTIMETRE
4°44'
57°9'
4°43'
4°42'
4°41'
57°8'
Creag an Iar-fhlaith
River Oich
CALEDONIAN CANAL
Station
Locks
Church
P.O.
Bunoich
Pier Sta.
Marketthill
St Peter's Chapel
(R.C.)
Fort Augustus
Lighthouse
Bridge of Tarff
River Tarff
Borlum
Tomanhoid

BATHYMETRICAL SURVEY OF THE FRESH-

UNDER THE DIRECTION OF

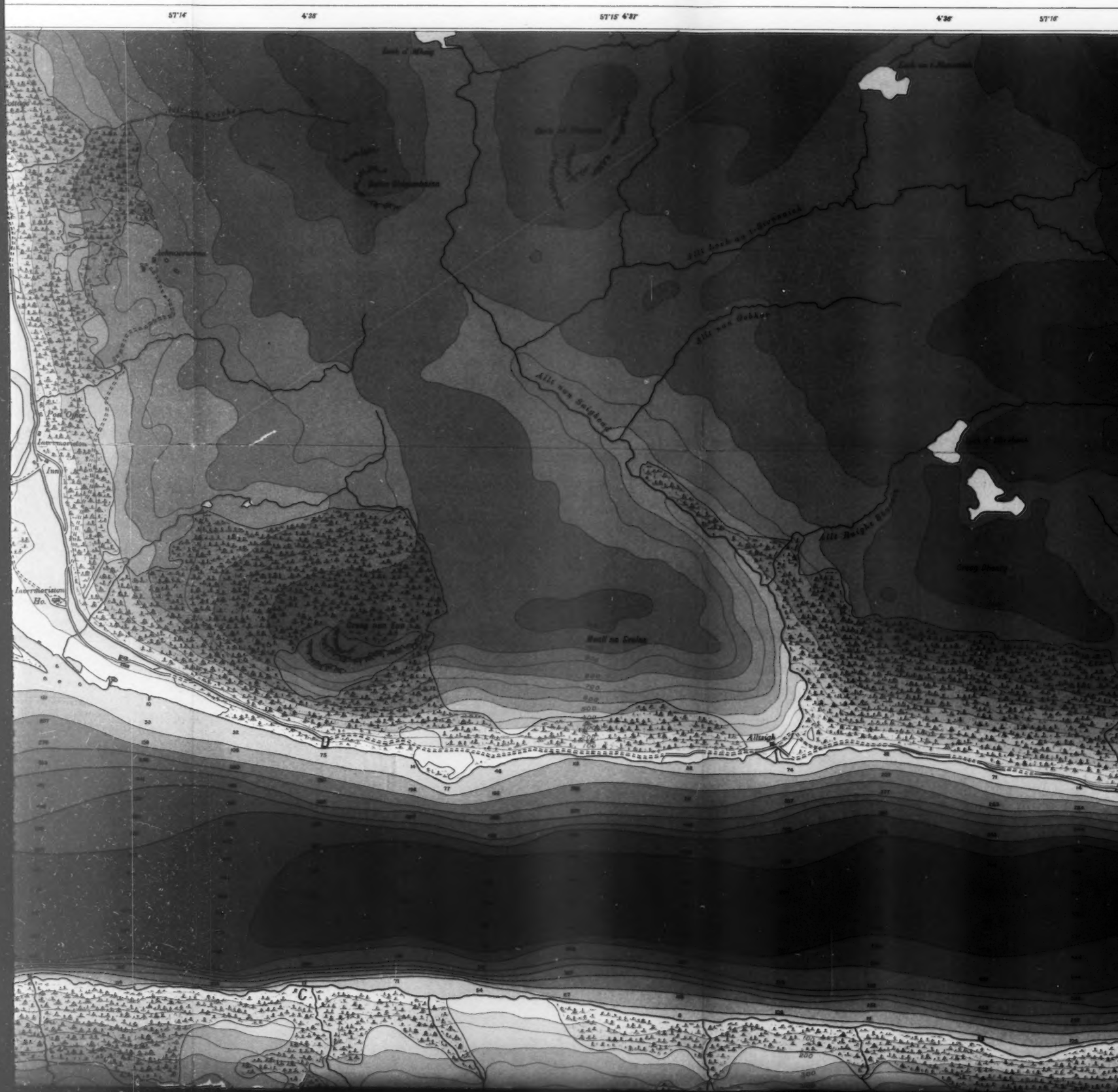
SIR JOHN MURRAY, K.C.B., F.R.S., D.Sc., AND LA-

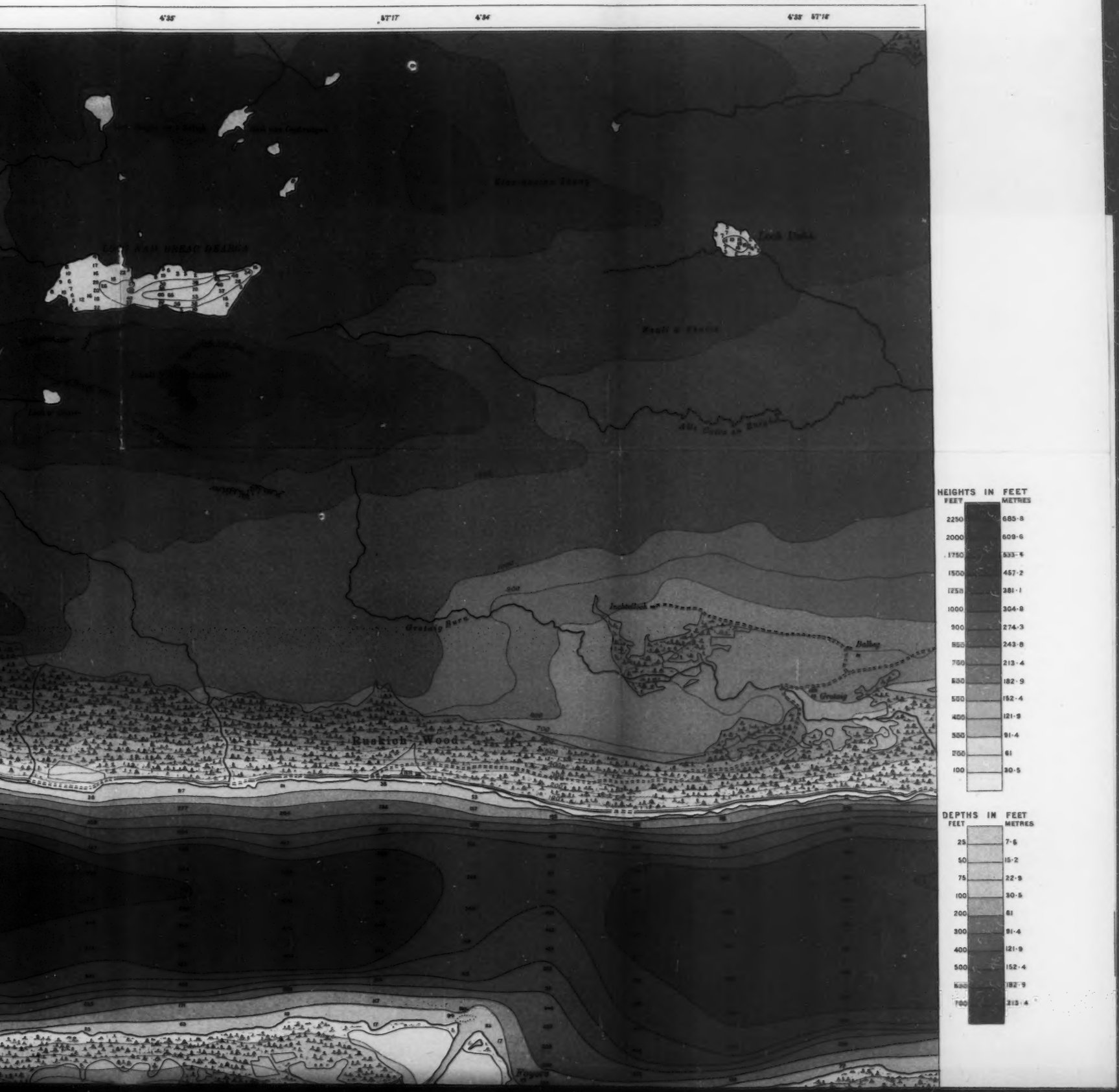


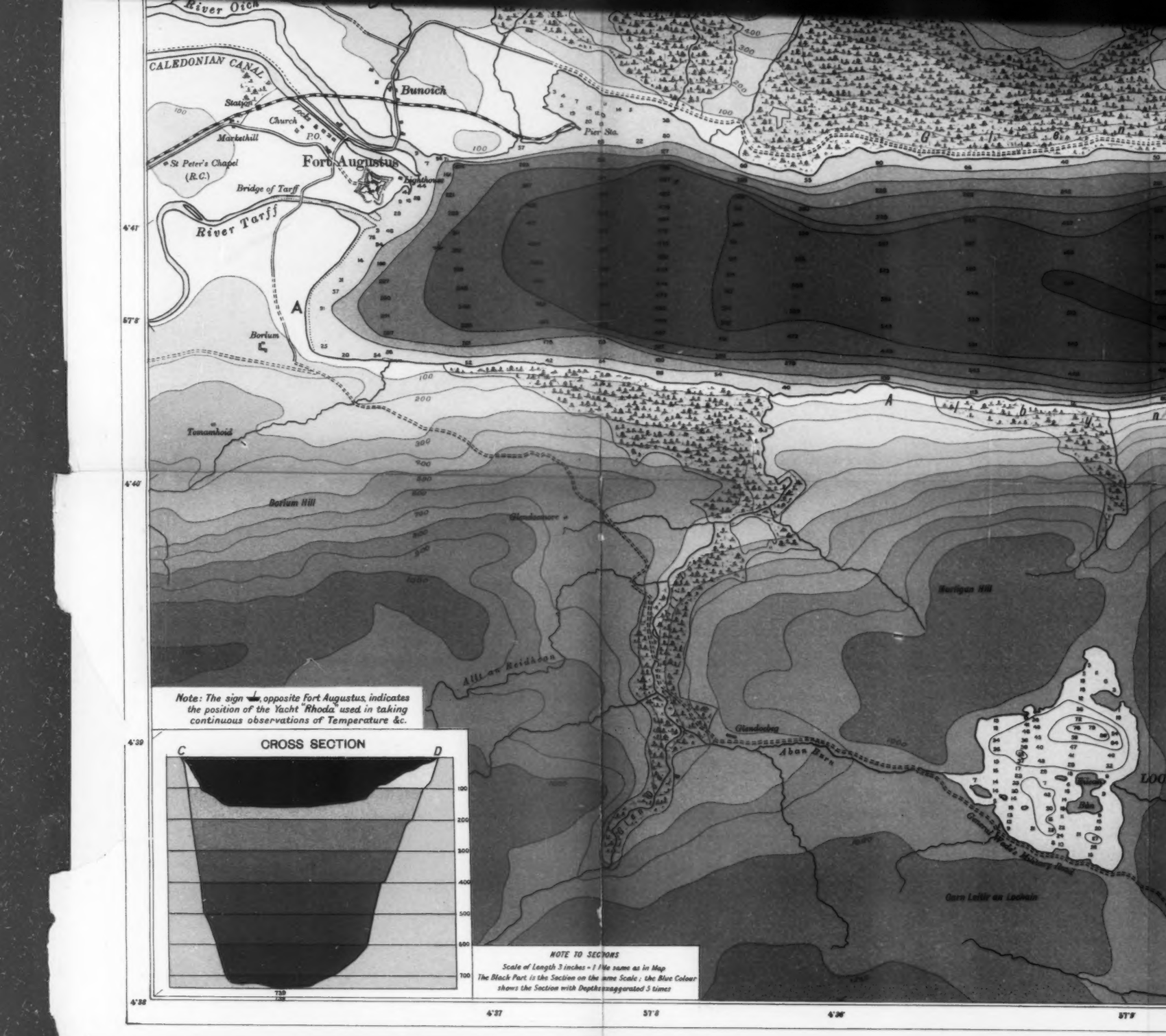
OF THE FRESH-WATER LOCHS OF SCOTLAND

UNDER THE DIRECTION OF

K.C.B., F.R.S., D.Sc., AND LAURENCE PULLAR, F.R.S.E.



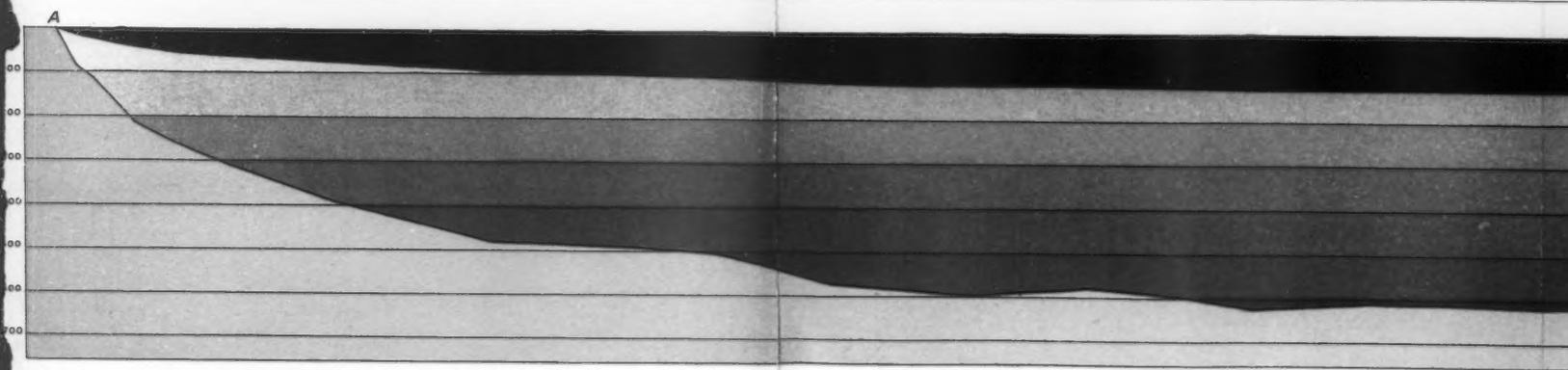

4'35
57'17
4'34
4'33
57'16
Ruskich Wood
Grotaig Burn
Balloy
Grotaig
HEIGHTS IN FEET
FEET
METRES
2250 685·8
2000 609·6
1750 533·4
1500 457·2
1250 381·1
1000 304·8
900 274·3
800 243·8
700 213·4
600 182·9
500 152·4
400 121·9
300 91·4
200 61
100 30·5
DEPTHS IN FEET
FEET
METRES
25 7·6
50 15·2
75 22·9
100 30·5
200 61
300 91·4
400 121·9
500 152·4
600 182·9
700 213·4



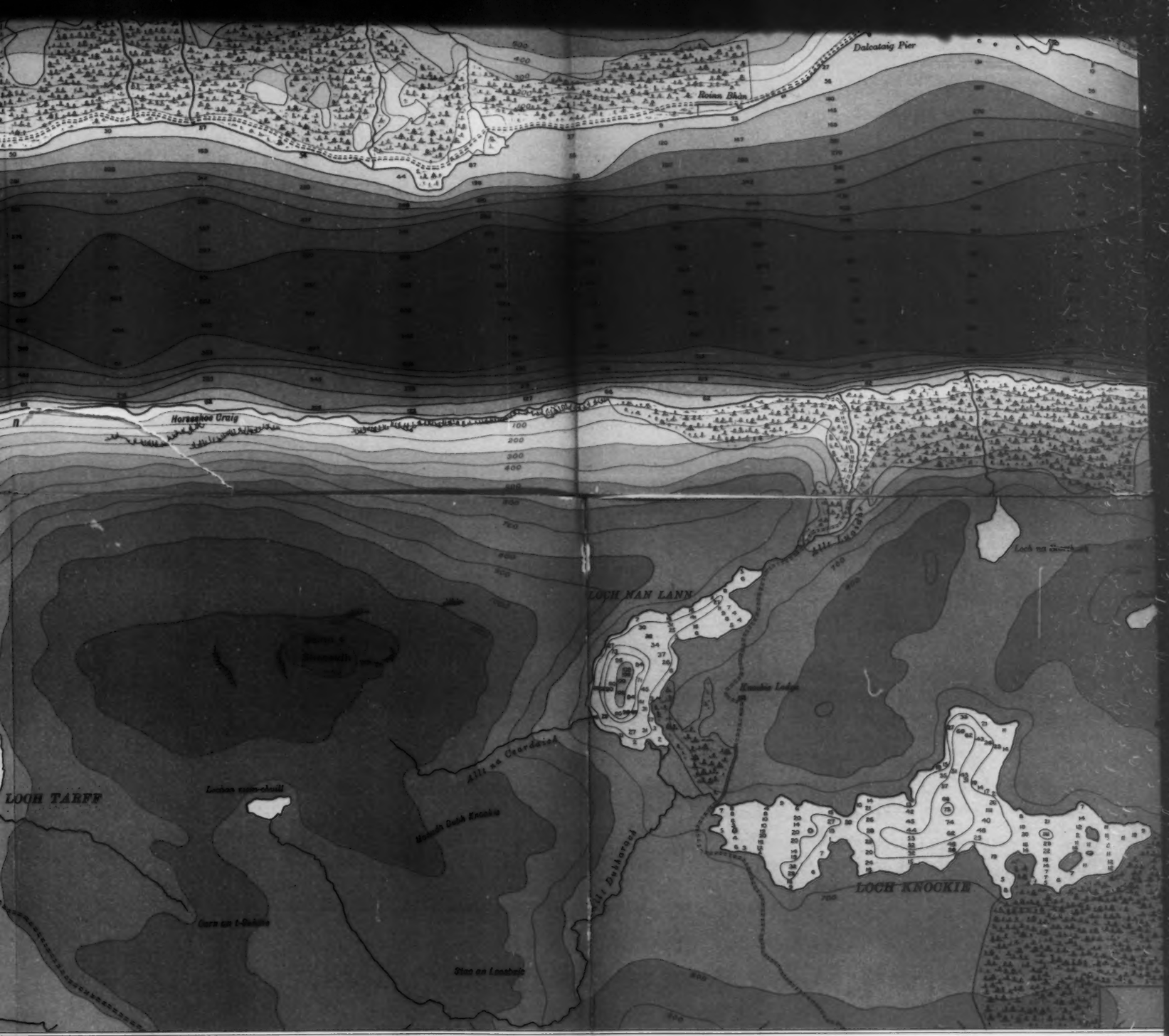
Note: The sign ⛵ opposite Fort Augustus, indicates the position of the Yacht "Rhoda" used in taking continuous observations of Temperature &c.

NOTE TO SECTIONS

Scale of Length 3 inches = 1 Mile same as in Map
The Black Part is the Section on the same Scale; the Blue Colour shows the Section with Depths exaggerated 5 times

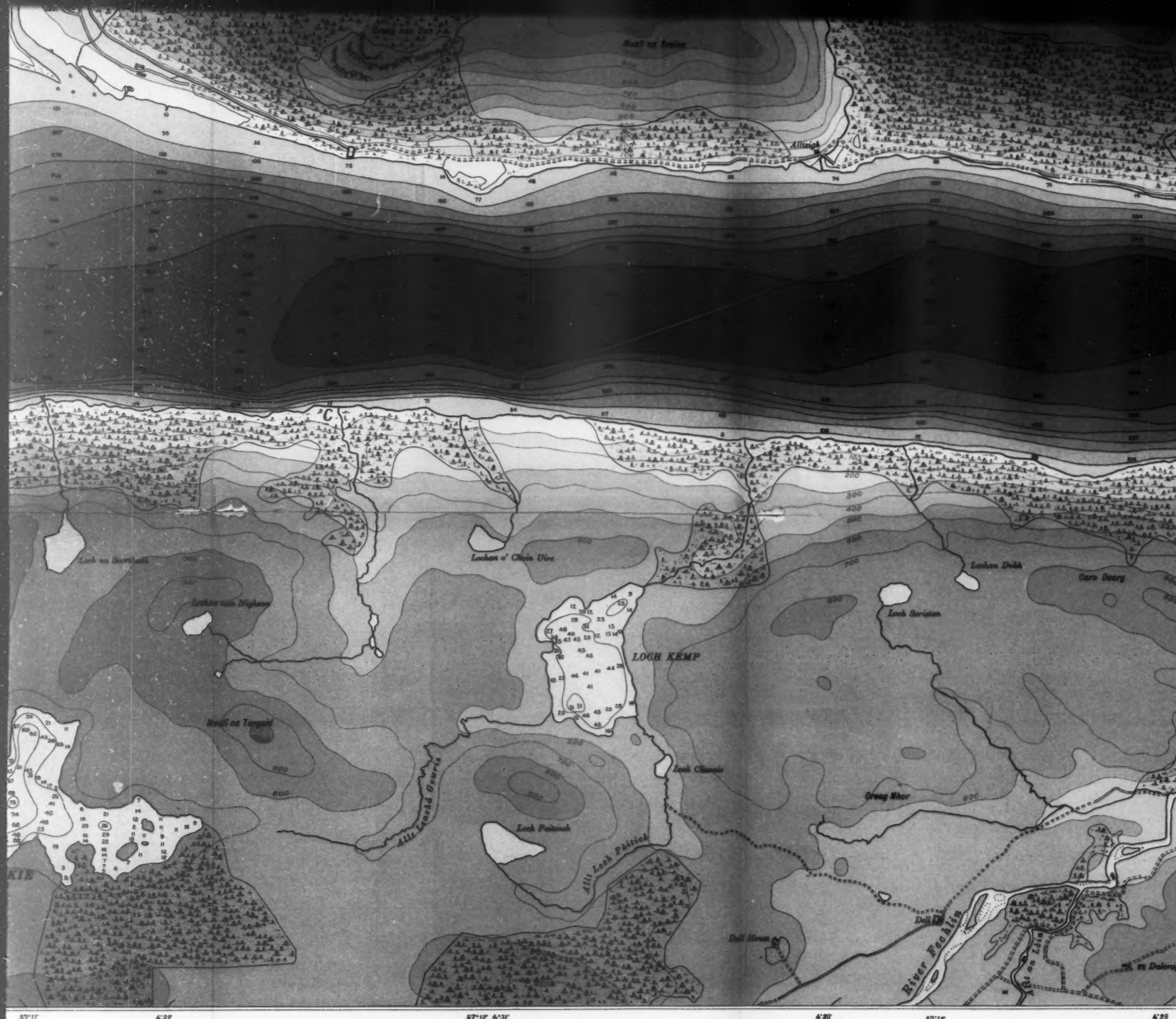


The Edinburgh Geographical Institute



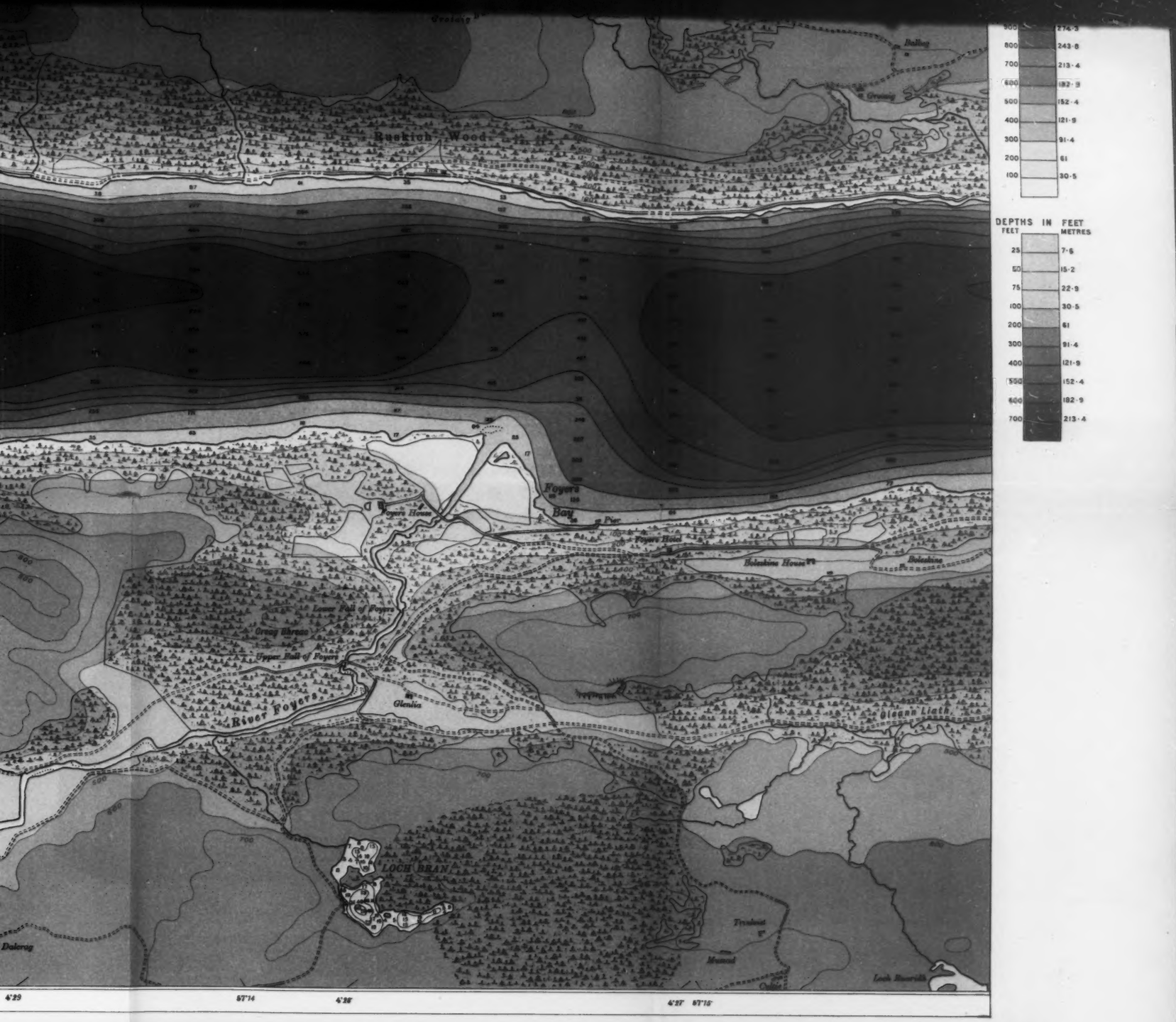
LONGITUDINAL SECTION ALONG AXIS

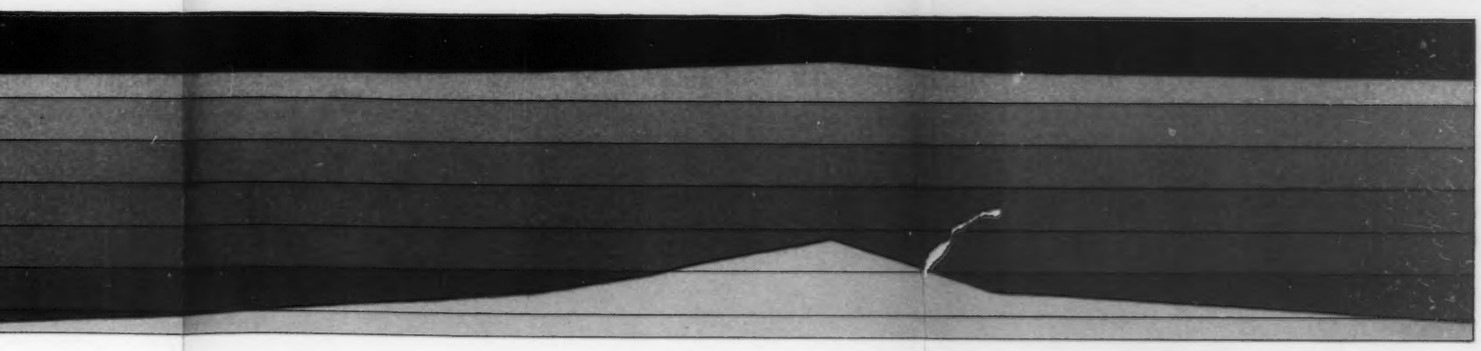
Published by the Royal Geographi



SECTION ALONG AXIS OF MAXIMUM DEPTH

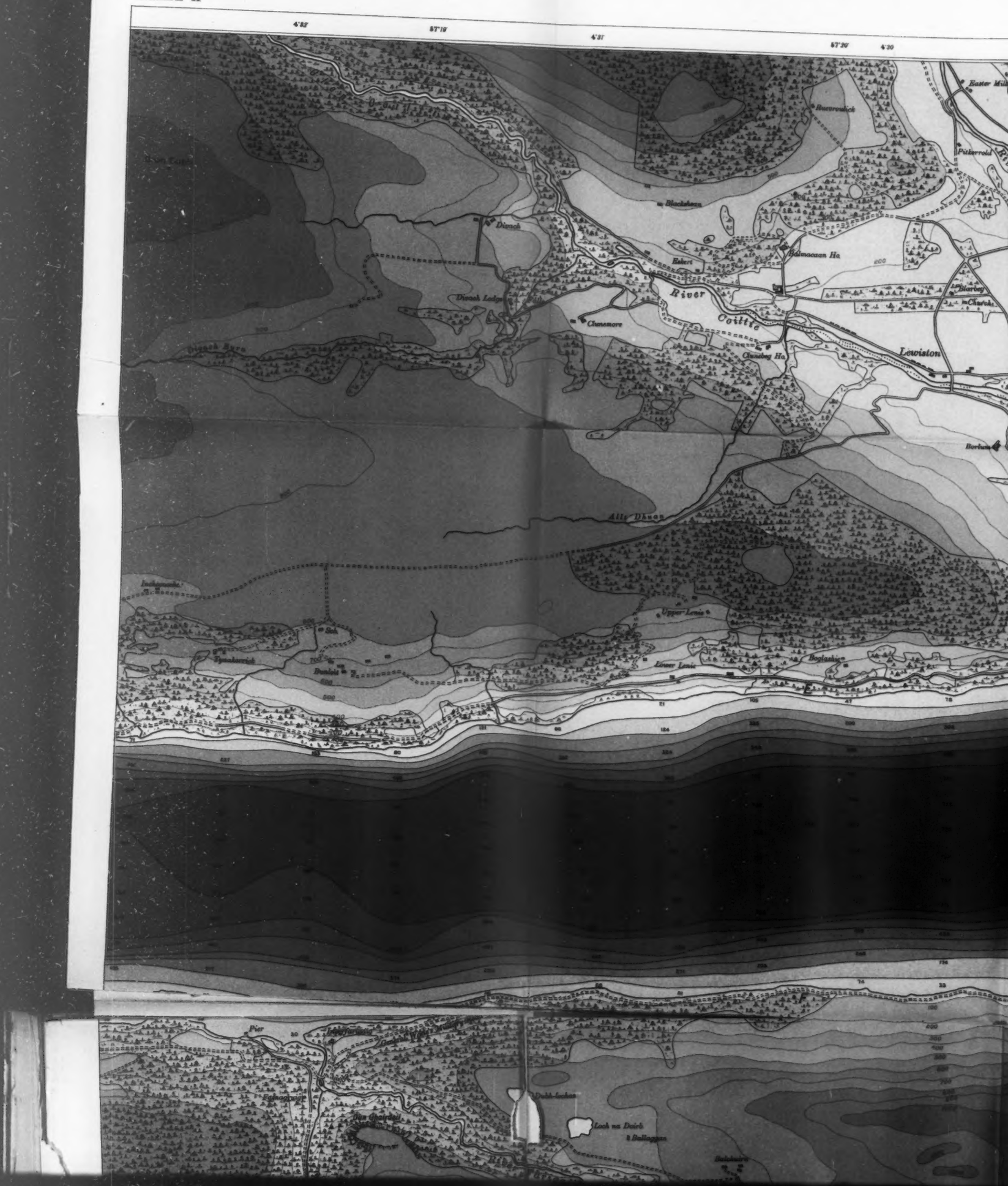
Published by the Royal Geographical Society





J. G. Bartholomew

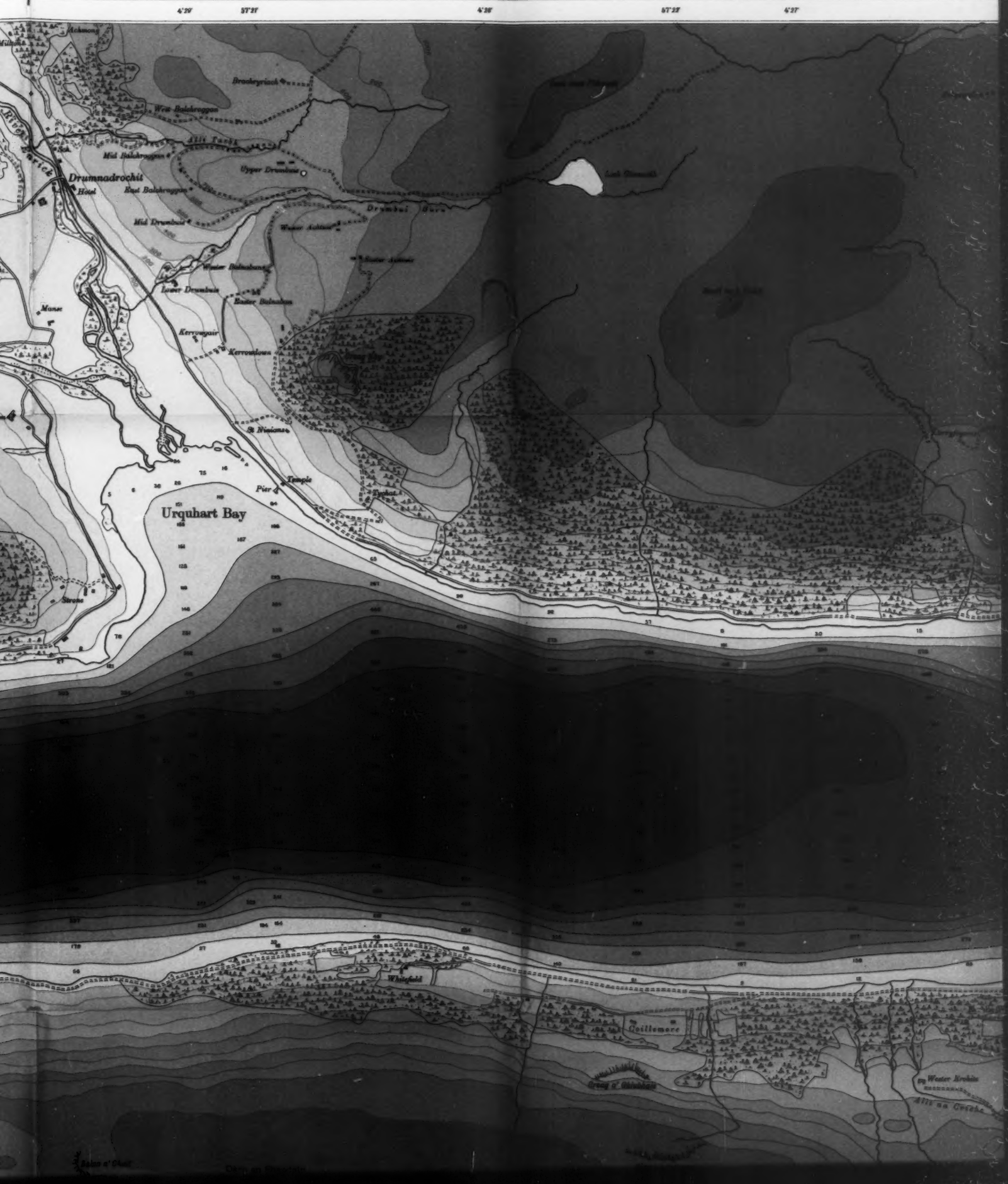
PLATE II


4°32
57°18
4°31
57°20
4°30
Easter Mill
Rosevraick
Pitkerrold
Blackshean
Divach
Eskert
Balmacaan Ha
River
Coiltie
Divach Lodge
Clunemore
Blarivey
Chapel
Lewiston
Divach Burn
Glenbeg Ha
Borlum
Allt Dhuon
Inchgarnie
Upper Lewis
Sch
Tynakerrich
Dunbeid
Lower Lewis
Boglashie
Pier
Dubh-lochan
Loch na Doirb
Ballaggan

BATHYMETRICAL SURVEY OF THE FRESH-

UNDER THE DIRECTION OF

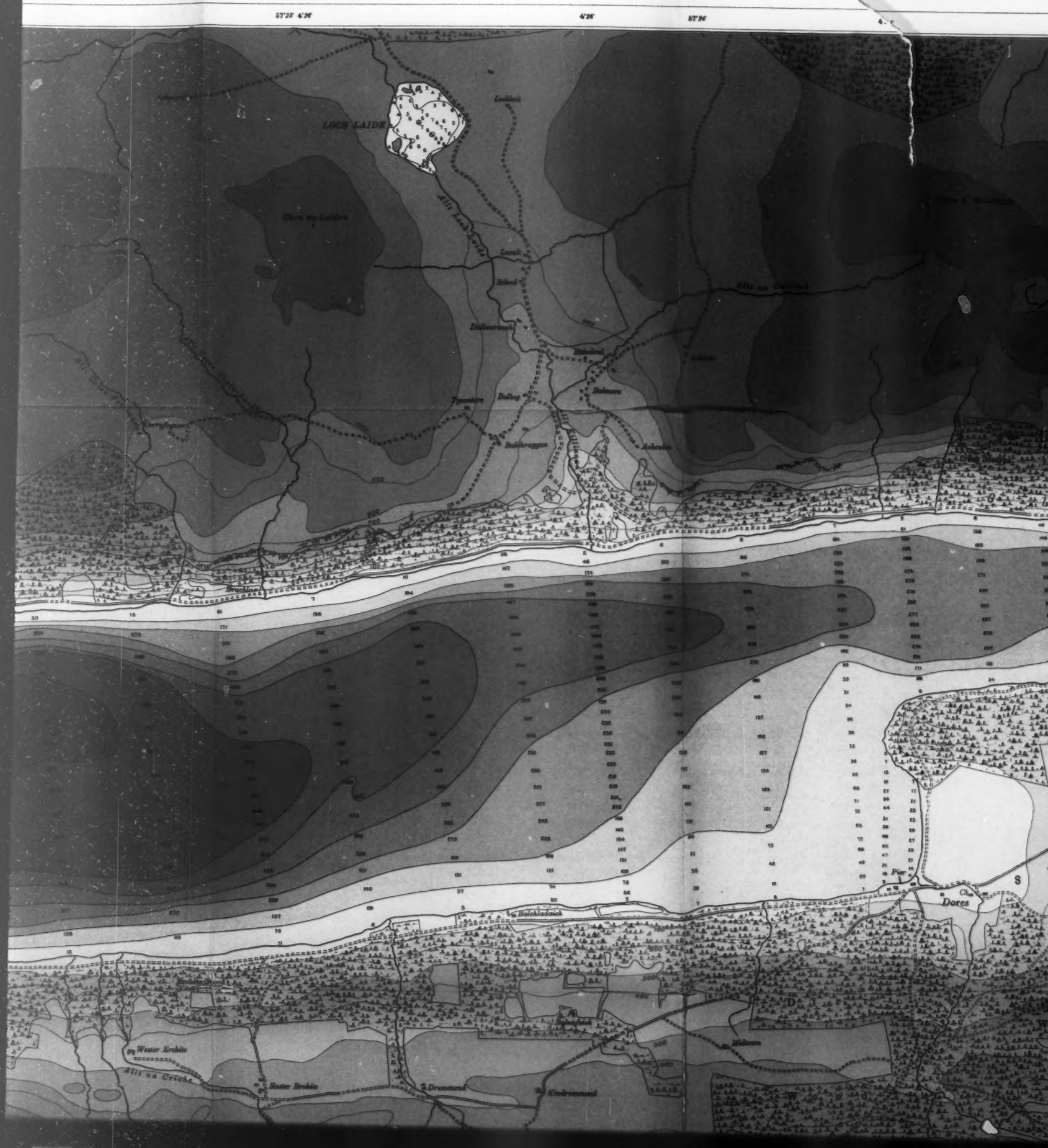
SIR JOHN MURRAY, K.C.B., F.R.S., D.Sc., AND LA



Y OF THE FRESH-WATER LOCHS OF SCOTLAND

UNDER THE DIRECTION OF

Y, K.C.B., F.R.S., D.Sc., AND LAURENCE PULLAR, F.R.S.E.



LOCH NESS

LOWER SECTION, INCLUDING

LOCHS LAIDE & ASHIE

(NESS BASIN)

SURVEYED IN 1903 AND 1904 BY

SIR JOHN MURRAY, K.C.B., F.R.S., T. N. JOHNSTON, M.B., C.M., T. R. H. GARRETT, B.A.
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R. C. MARSHALL, M.A., AND F. G. PEARCEY.

Height of Surface of Water above Sea Level—Loch Ness 52·6 feet—Loch Ashie 717·75 feet

The Land Contours are from the Ordnance Survey

Scale 1: 21,120 3 INCHES TO 1 MILE

0 Mile 1

0 Kilometres 1·61

0·21 KILOMETRE — 1 CENTIMETRE

HEIGHTS IN FEET

FEET	METRES
1500	457·2
1250	381·1
1000	304·8
900	274·3
800	243·8
700	213·4
600	182·9
500	152·4
400	121·9
300	91·4
200	61
100	30·5

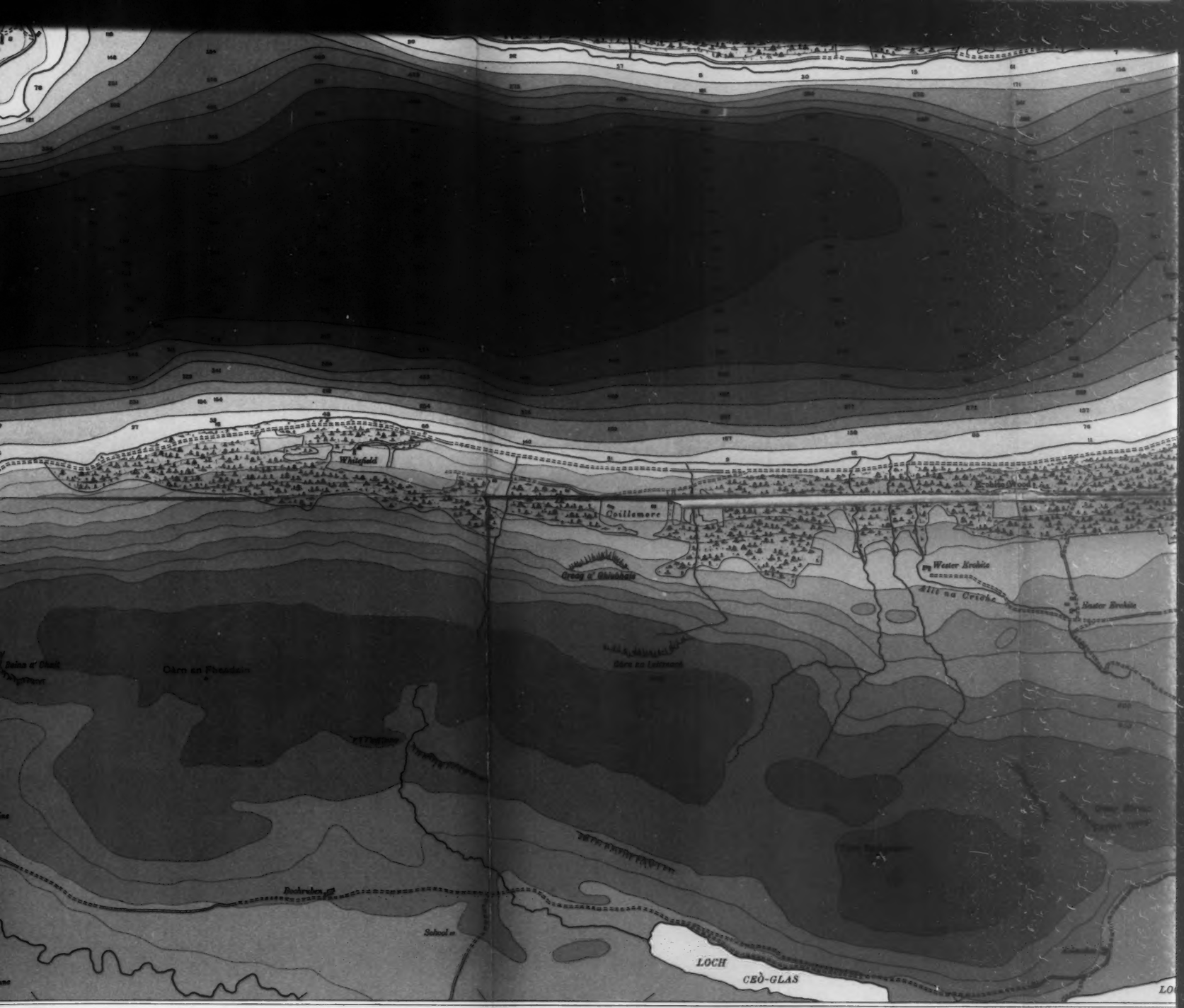
DEPTHS IN FEET

FEET	METRES
25	7·6
50	15·2
75	22·9
100	30·5
200	61
300	91·4
400	121·9
500	152·4
600	182·9
700	213·4

57°25′ 4°23′ 4°22′ 57°26′ 4°21′ 4°20′ 4°19′ 57°26′ 4°18′ 4°17′ 4°16′ 57°25′

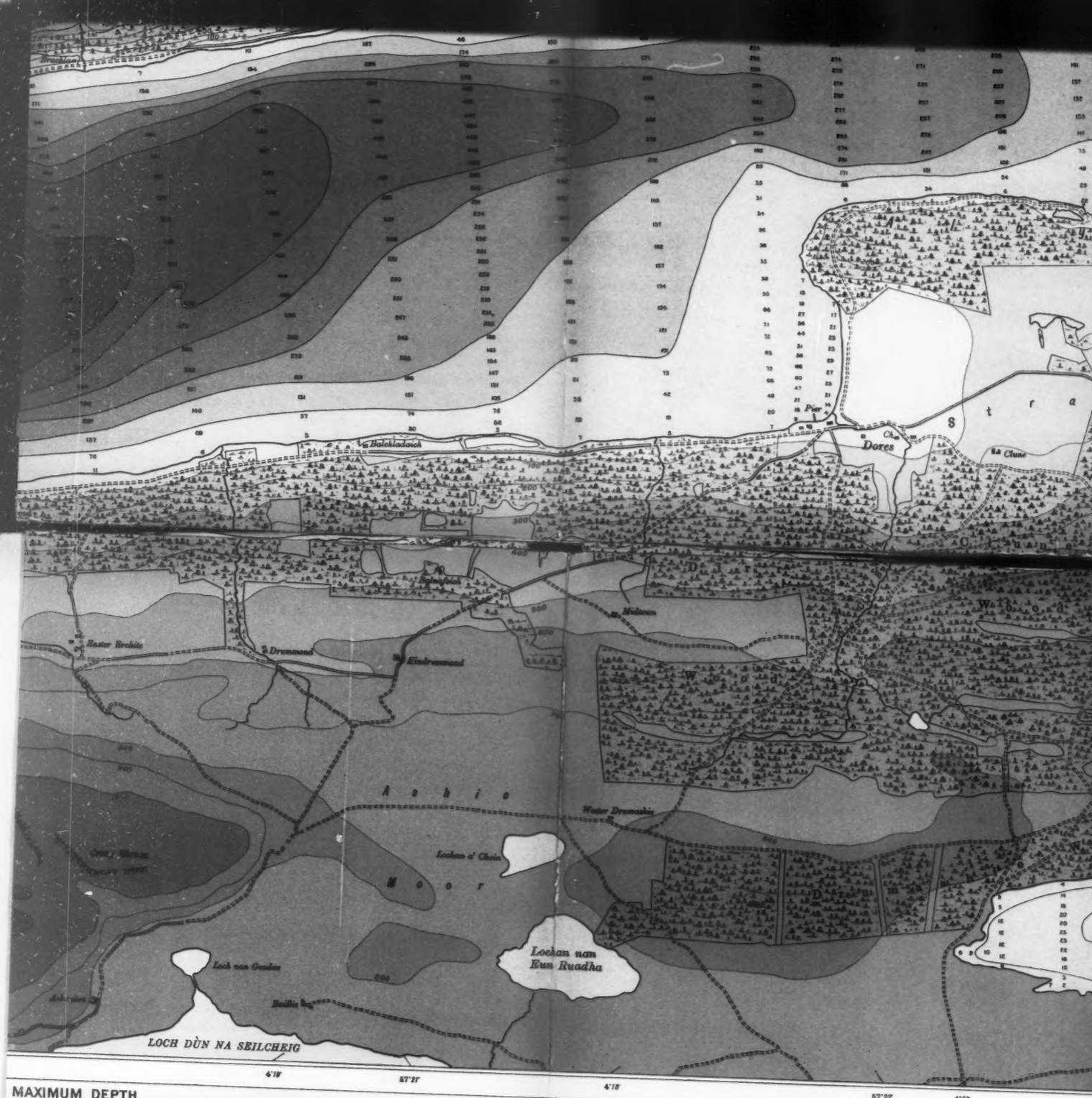
Daire Mhor
Allt a' Mhuilinn
Ballimore
Battlefield
Doonalary
Dochfour House
Glackoulish
Balsporran
Laigmore
Lochend
Kirkton
Middleton
Church
Inn
Woodend
Abban Water
Lighthouse
Weir
River Ness
LOCH DOCHFOUR
Ballandarroch
Balnore
Aldourie Castle
Bona
Douroag Burn
General Wade's Military Road
School
Dares
Antfield
Kinchyle
Allt na Sruthlaig
Balnafraig
Midtown
Drumashie Moor

The Edinburgh Geographical Institute



LONGITUDINAL SECTION ALONG AXIS OF MAXIMUM DEPTH

Published by the Royal Geographical Society



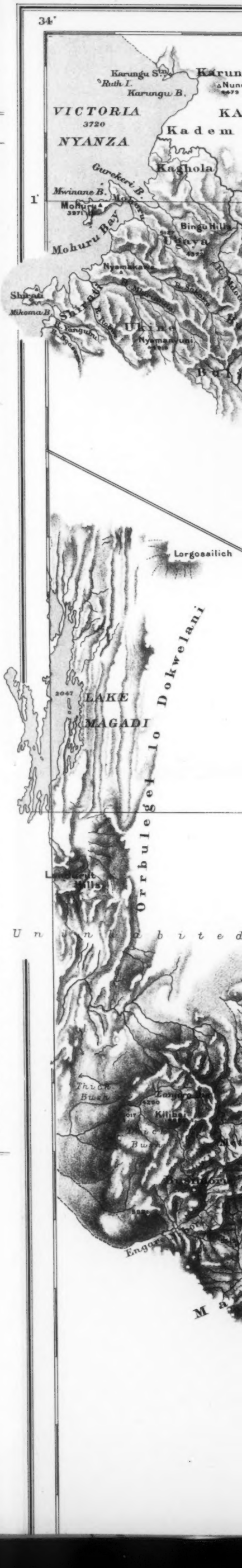
MAXIMUM DEPTH

Society

J. G. Bartholomew

LATITUDES AND LONGITUDES OF TRIANGULATION STATIONS.

Name of Trig. Station.	Latitude.	Longitude.
	° ′ ″	° ′ ″
Kisumu	00 06 01·16 S.	34 44 44·72 E.
Maraguil	00 00 17·61 ,,	34 39 34·40 ,,
Kibuye	00 08 31·46 ,,	34 43 55·96 ,,
Ndere	00 12 24·28 ,,	34 30 24·32 ,,
Wire	00 28 09·50 ,,	34 42 35·23 ,,
Homa	00 23 14·82 ,,	34 29 46·08 ,,
Gem	00 38 02·78 ,,	34 31 44·17 ,,
Ruri	00 33 23·41 ,,	34 21 41·00 ,,
Mbala	00 47 57·49 ,,	34 26 13·53 ,,
Gwasi	00 37 33·07 ,,	34 11 21·38 ,,
Uganju	00 46 27·60 ,,	34 05 04·16 ,,
Nundowat	00 51 30·82 ,,	34 12 37·51 ,,
Mohuru	01 00 24·74 ,,	34 03 48·59 ,,
Kwere	01 03 09·25 ,,	34 19 02·06 ,,
Nyamanyuni	01 10 46·76 ,,	34 07 16·42 ,,
Guigeggo	01 14 52·72 ,,	34 17 04·20 ,,
Shirari	01 15 24·92 ,,	34 28 16·77 ,,
Sigaa	01 08 24·98 ,,	34 44 09·07 ,,
Tagari	01 23 32·80 ,,	34 37 16·04 ,,
Kijarimweta	01 21 21·20 ,,	34 51 34·47 ,,
Moggone	01 25 12·92 ,,	35 00 25·06 ,,
Nesheshaw	01 38 43·51 ,,	34 55 03·58 ,,
Kebololet	01 34 46·95 ,,	35 09 02·65 ,,
Kuka	01 43 00·39 ,,	35 15 04·54 ,,
Leganisho	01 35 50·32 ,,	35 24 06·58 ,,
Kebololet O.S.	01 35 56·07 ,,	35 08 19·63 ,,
Ol Albwa	01 40 19·80 ,,	35 30 41·81 ,,
Mundorosi	01 53 03·24 ,,	35 26 52·40 ,,
A.	01 47 22·88 ,,	35 41 51·33 ,,
Ndasegera	01 57 59·49 ,,	35 42 43·99 ,,
Escarpment	01 50 57·21 ,,	35 57 07·96 ,,
Shombole	02 07 33·71 ,,	36 05 47·90 ,,
12	02 02 21·92 ,,	36 20 58·21 ,,
Guaso Nyiro (Base North)	02 01 00·45 ,,	36 08 27·61 ,,
Kilibei	02 22 22·29 ,,	36 26 27·30 ,,
Luanji	02 13 19·84 ,,	36 33 47·78 ,,
Erok	02 29 38·86 ,,	36 44 56·69 ,,
Elemobarasha	02 13 02·53 ,,	36 52 47·45 ,,
Meshanai	02 32 17·73 ,,	37 10 55·42 ,,
Enoiiti	02 46 37·27 ,,	37 07 04·01 ,,
Naduyatui	02 42 30·75 ,,	37 29 21·87 ,,
Endoinet	02 55 19·72 ,,	37 25 34·40 ,,
Loosoito	02 42 12·17 ,,	37 37 08·84 ,,
Lolgaria	02 56 03·05 ,,	37 35 32·32 ,,
East Terminal	02 57 19·88 ,,	37 31 17·30 ,,
Laitokitok	02 56 13·97 ,,	37 31 17·37 ,,
Soiti Sambu	02 44 58·33 ,,	37 49 30·65 ,,
Nagavai	03 00 47·66 ,,	37 44 07·48 ,,
Y	02 59 11·90 ,,	37 59 02·49 ,,
Loosoito (Mog. 9)	03 14 47·42 ,,	37 52 55·00 ,,
Chala	03 19 25·63 ,,	37 41 04·30 ,,
El Oldorobo	03 23 21·50 ,,	37 47 10·47 ,,
Mokinni	03 29 51·30 ,,	37 38 09·99 ,,
Jipé O. S.	03 34 29·63 ,,	37 46 12·49 ,,
Vilima Viwili	03 34 44·98 ,,	37 47 54·36 ,,
Kibo	03 04 34·60 ,,	37 21 03·60 ,,
Kimawenzi	03 05 38·61 ,,	37 27 18·39 ,,
Meru	03 14 33·00 ,,	36 44 50·90 ,,



SECTION I.

rungu
Nundowat
KAVIRONDO
m
4212
R. Kuja
Kenikweno
Kwanza
Sagegi
4810
Gori
Mwita
6567
Tunegi
Sigaa
4101
Bukwata
Gurrashi
Buganda
Kekuri
R. Gora
Loongary
Lareaga
Kowakowa
Chamotchi
Kwanza Mission
Mori
R. Mori
Yandoto
Utimbara
Simunda
Timbeta
5173
Mosonge
Urungu
Kwinyerya
Gongora
Nyarumau
Lamai
Elchungeri
Murtu
6746
R. Mara
Sodonaibi
Langalangati
Osera
Nessuhan
Mecheshwan
Songati
Ikorongo
Nyanja Joke
R. Somoye
2°
Mosongo
Kadida
Nigati
Nata
Wangwesi
Ikomba
Yapigan
Hills
Kokaia River
37°
35°
Gorigaishi
Hills
Langarunyeni
Moshanai
4000
Namanga
Namanga River
Ngarambeda
Ngararamani
Grass Plain
LAKE AMBOSELI
(Salt)
L. Nyiri
L. Kaigoni
Nanbor
Ngarerambi
Marenkeri
or Nankeseri
Nyaro
Hulia
Engutuk
Eibiti
Olgeni
Bush
Loirugumbo
Angaramuru
Grass Plains

VICTORIA NYANZ

of the country N

ANGLO GER

reduced fro

BRITISH AND GERMAN S

dur

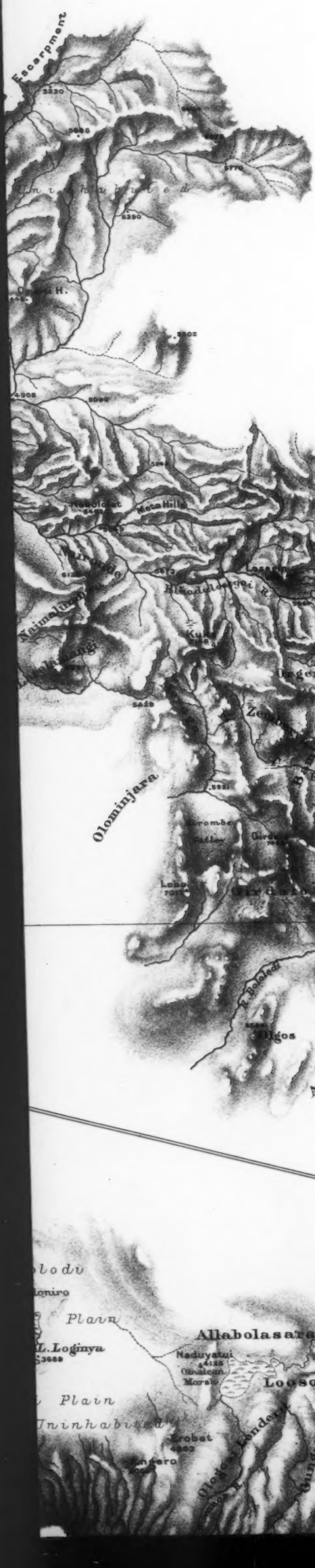
19

Scale 1 : 500,000

10 5 0

Heights in

Mean varia



36°

NZA TO Mt KILIMANJARO

MAP

ry North and South of the

GERMAN BOUNDARY

from the Surveys of the

N SECTIONS OF THE COMMISSIONS

during the years

1904 - 1906.

000 or 1 inch - 7·89 statute miles.

10 20 30

in feet above sea level.
variation of compass 6°50' W.

1°

2°

ubogo lo Loiitai

Marandawa Hills

7542

Legisartat Escarpment 7865 Hills

Namanguesa Hills

R. GUASO NYIRO

LAKE MAGADI

2047

2173

2037

2012

Sambu

LAKE NATRON

2000

2132

Himau

Loiogob Sec.

R. Sonyo Landari

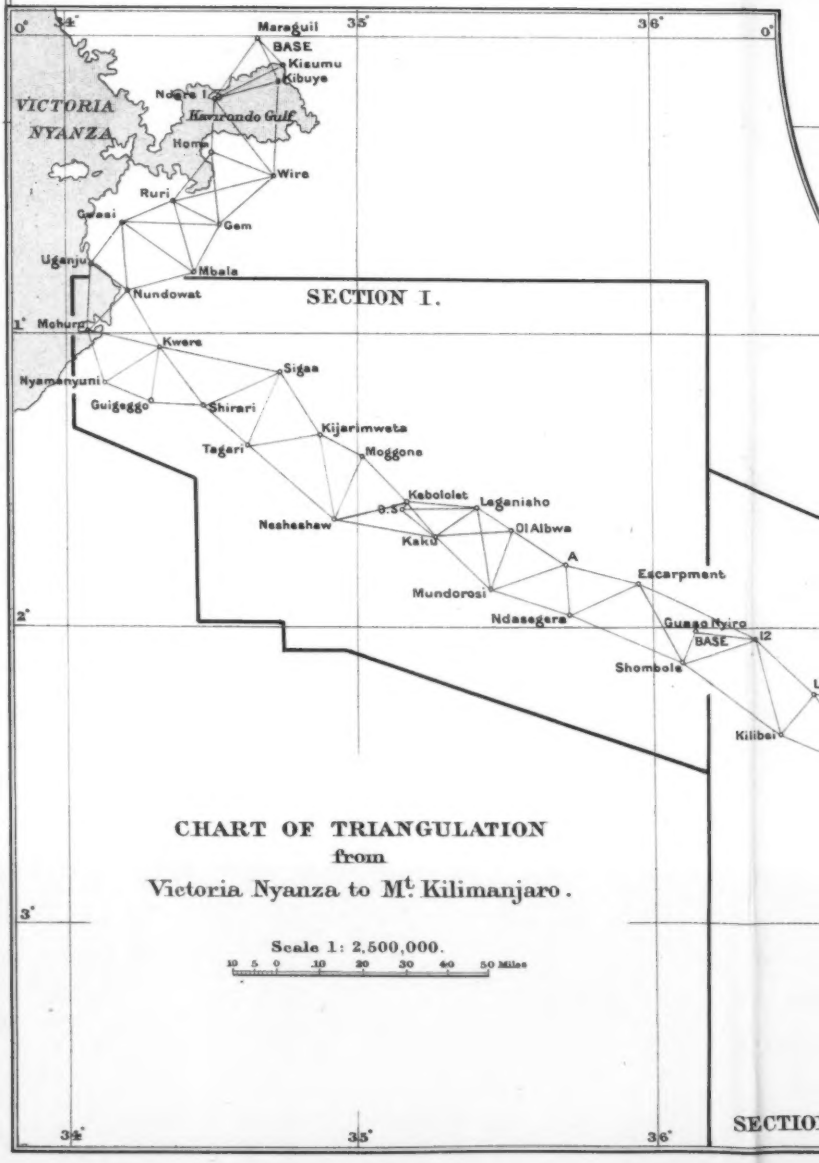
38°

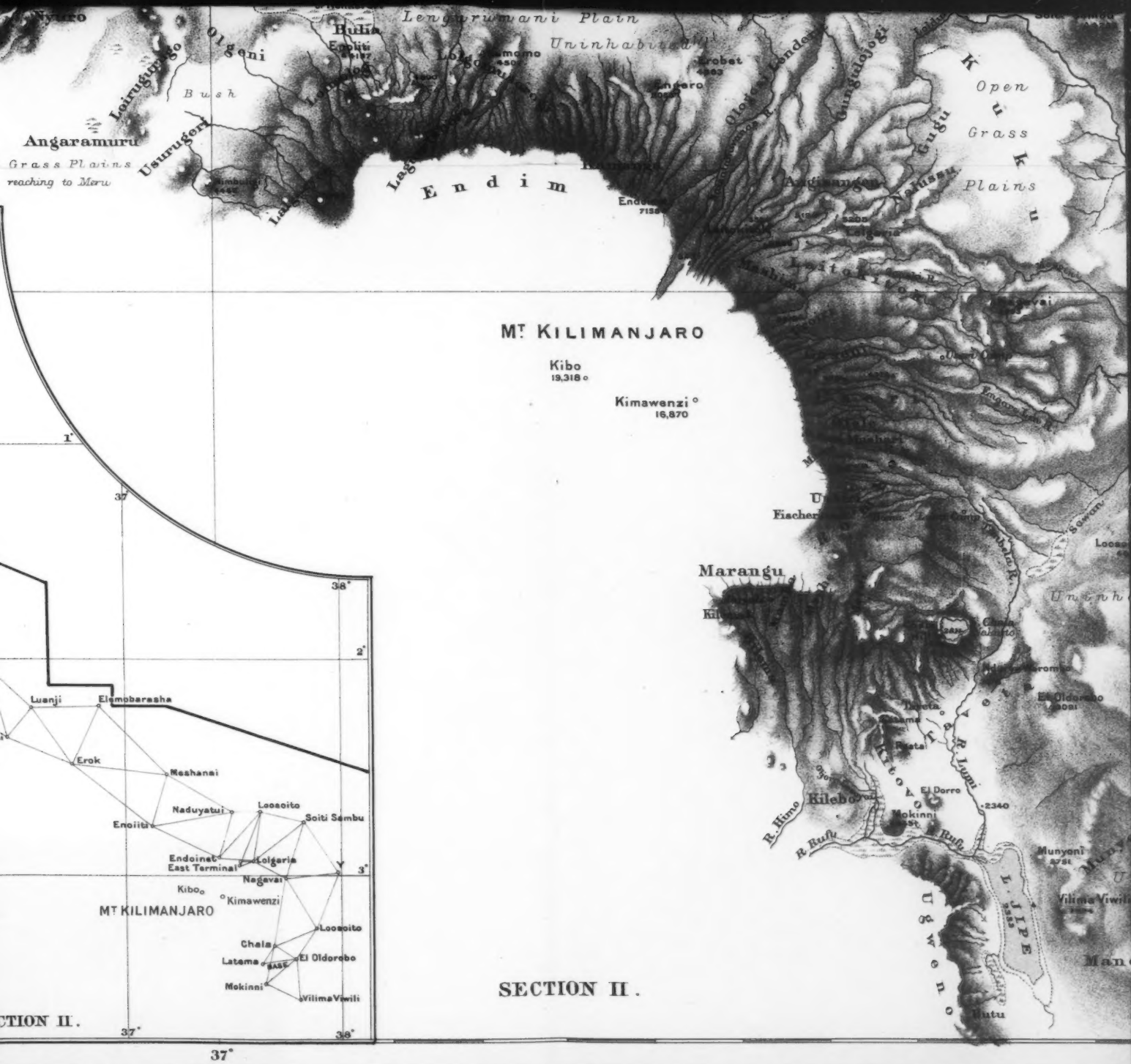
36°

ssien

untains

Kenani


0°
34°
35°
36°
Maraguil
BASE
Kisumu
Kibuye
Ndere I.
Kavirondo Gulf
VICTORIA NYANZA
Homa
Wire
Ruri
Gwasi
Gem
Uganju
Mbale
Nundowat
SECTION I.
1°
Mohuru
Kwere
Sigaa
Nyamanyuni
Guigeggo
Shirari
Kijarimwata
Tagari
Moggone
Kabololet
Laganiaho
B.S.
Nesheshaw
Kaku
Ol Albwa
A
Escarpment
Mundorosi
2°
Ndasegera
Gumgo Nyiro
BASE
12
Shombole
Kilibei
CHART OF TRIANGULATION
from
Victoria Nyanza to Mt. Kilimanjaro.
3°
Scale 1: 2,500,000.
10 5 0 10 20 30 40 50 Miles
34°
35°
36°



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Note. For information concerning the construction of this map, see the paper by Captain G. E. Smith, R.E., and the note by Captain T. T. Behrens, R.E., in the "Geographical Journal" for March and July 1907.